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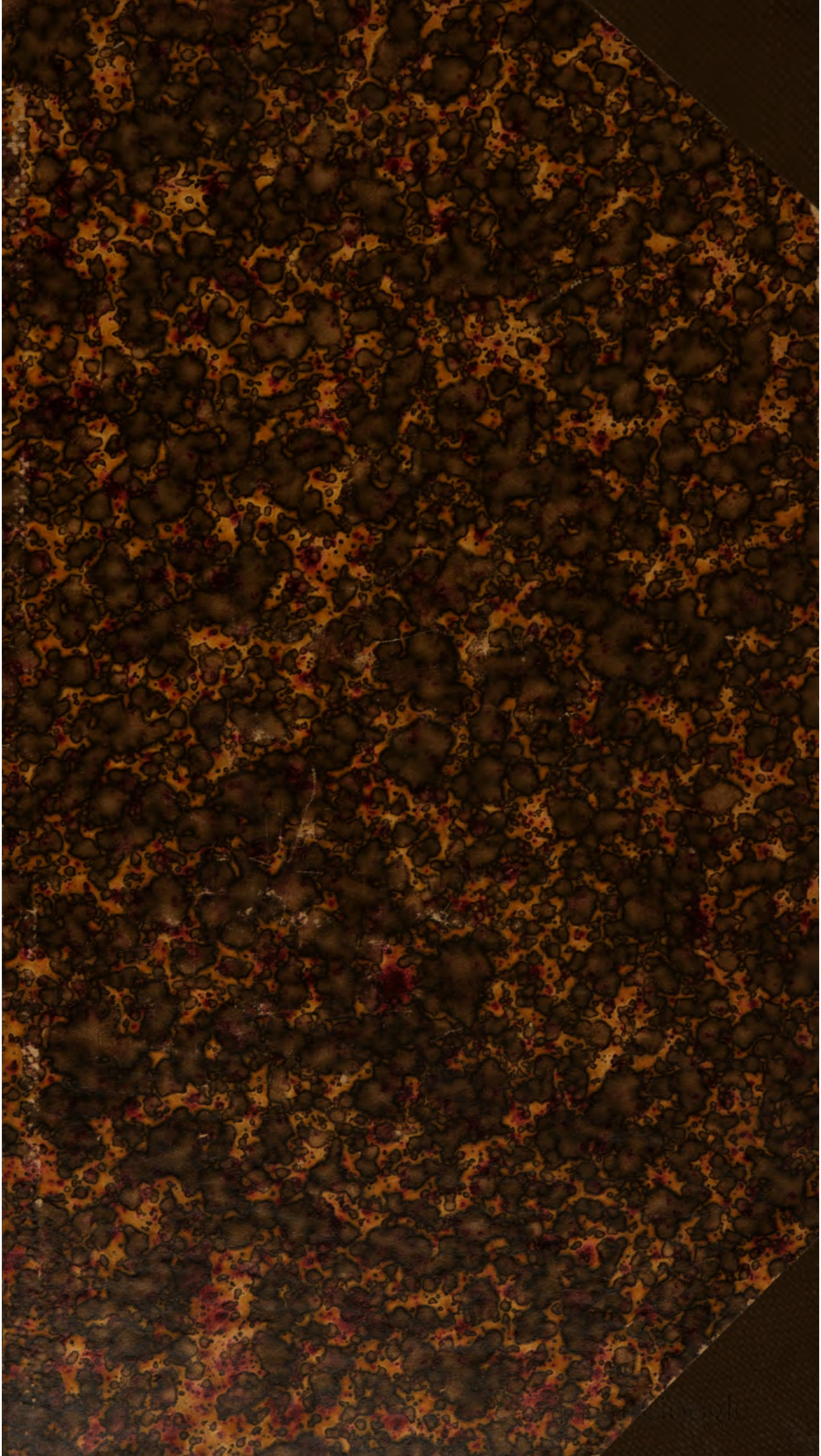

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PROCEEDINGS

OF THE

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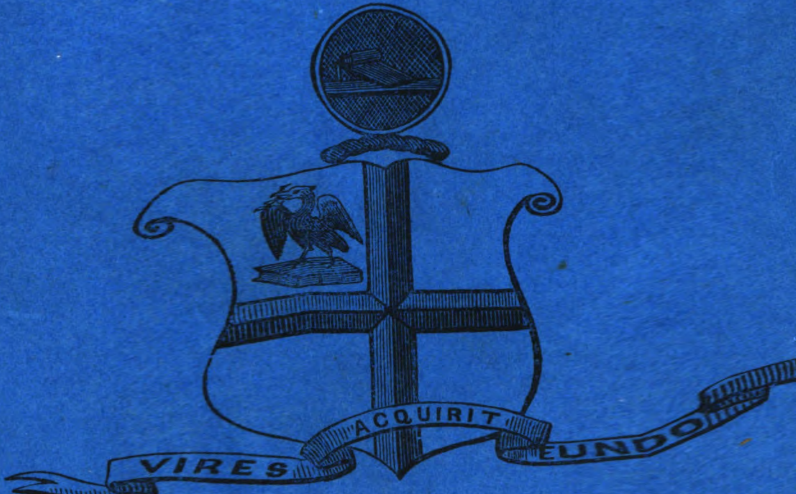
OF

LIVERPOOL,

DURING THE

FIFTIETH SESSION, 1860-61.

No. XV.



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PRINTED FOR THE MEMBERS OF TH
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1861.

PROCEEDINGS

OF THE

LITERARY AND PHILOSOPHICAL SOCIETY

OF

LIVERPOOL,

DURING THE

FIFTIETH SESSION, 1860-61.

No. XV.

LIVERPOOL:
PRINTED FOR THE MEMBERS OF THE SOCIETY,
BY THOMAS BRAKELL, 7, COOK STREET.

1861.

This Volume has been edited by the Hon. Secretary.

The Authors have usually revised their papers.

The Authors alone are responsible for facts and opinions.

The Society exchanges Proceedings with other publishing bodies, through the Secretary, from whom back numbers may be obtained.

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Prof. Dadabhai Naoroji.
Charles Clark.
Thos. J. Moore, C.M.Z.S.
(Elected Feb. 18th.)

ORDINARY MEMBERS

ON THE SOCIETY'S ROLL AT THE CLOSE OF THE 50th SESSION.

Those marked + are Original Members of the Society.

Life Members are marked with an asterisk.

Oct. 11, 1833 Aikin, James, Esq., 2, *Drury-lane*, and 4, *Gambier-terrace.*
Dec. 10, 1860 Alexander, James, 8, *York Buildings*, *Dale-street*, and 24, *Bedford-street South.*
Jan. 8, 1861 Anderson, David, 7, *Church-street*, *Egremont.*
Dec. 11, 1854 Andrew, John, *Fenwick chambers*, and *Sandown-park*, *Wavertree.*

*Nov. 28, 1853 Archer, Thomas Croxen, *Industrial Museum of Scotland, Edinburgh.*

Nov. 18, 1852 Atkin James, 190, *Grove-street.*

Feb. 22, 1855 Avison Thomas, F.S.A., 18, *Cook-street*, and *Fulwood-park, Aigburth.*

Dec. 10, 1860 Baar, Rev. Hermann, Ph.D., 15, *Sandon street.*

May 1, 1854 Bahr, George W., 4, *Cable-street*, and 2, *South-hill Grove, Aigburth.*

Oct. 29, 1860 Banister, Rev. W., B.A., Hon. Secretary to the Liverpool Naturalists' Field Club, *St. James' Mount.*

Oct. 31, 1859 Batty, Thomas, M.R.C.S., *Greenfield House, Liscard-rd.*

March 9, 1857 Bell, Christopher, *Moor-st.*, and 60, *Bridge-st., Birkenhead.*

Feb. 6, 1854 Bennett, William, 65, *Sir Thomas's Buildings*, and 109, *Shaw-street.*

Oct. 31, 1859 Birch, James, 13, *Rumford-place*, and 7, *Upper Baker-st.*

Feb. 4, 1856 Bird, W. Vallentine, M.D. Aberd., *Seacombe.*

April 15, 1861 Blake, James, 63, *Kitchen-street*, and 45, *Canning-street.*

Oct. 31, 1859 Bloxam, Frederick William, *Liverpool and London Insurance Buildings, Exchange.*

Nov. 7, 1834 Boult, Francis, 26, *Chapel-street*, and 15, *Devonshire-place, Claughton.*

*Mar. 6, 1835 Boult, Swinton, 1, *Dale-street*, and 3, *Bedford-street South.*

Nov. 13, 1854 Bretherton, Edward, F.G.S., 21, *Harrington-street*, and 47, *Hamilton-square, Birkenhead.*

Oct. 21, 1844 Bright, Samuel, Esq., 1, *North John-street*, and *Sandheys, Mill-lane, West Derby.*

*Jan. 8, 1855 Brockholes, James Fitzherbert, *Puddington Old Hall, near Neston.*

May 5, 1851 Brougham, James Rigg, Barrister-at-Law, Registrar Court of Bankruptcy, *Eldon Chambers*, 20, *South John-street*, and 3, *St. Aidan's-terrace, Claughton.*

May 3, 1857 Burton, Rev. Charles Henry, M.A., 1, *Sandon-terrace.*

*May 1, 1848 Byerley Isaac, F.L.S., F.R.C.S., *Victoria road, Seacombe.*

Dec. 1, 1851 Clare, John Leigh, 11, *Exchange-buildings*, and 22, *Richmond-terrace, Breck-road.*

Oct. 31, 1859 Clark, Charles, 17, *North John street*, and *Rock Ferry.*

Jan. 26, 1857 Clay, William, 97, *Sefton-street*, and 4, *Parkhill-road.*

Nov. 16, 1857 Cooper, Joseph, *Oak House, Aigburth.*

May 31, 1858 Collingwood, Cuthbert, M.A., M.B., Oxon, M.R.C.P., F.L.S., Lect. on Botany, Royal Infirmary Sch. of Med.; Professor of Physiology, Queen's Coll.; Phys. to the Northern Hospital; 15, *Oxford-street.*

Jan. 22, 1850 Cox, Henry, 19, *Brunswick-street,* and *Poplar-rd., Oxton.*

Jan. 26, 1857 Dadabhai Naoroji, Professor of Gujarati, London University, 32, *Great St. Helens, London, E.C.*

*April 6, 1840 Dickinson, Joseph, M.A., M.D. Dub. and Cantab. F.R.C.P., F.R.S., M.R.I.A., F.L.S., 92, *Bedford-street South.*

Dec. 12, 1859 Dobson, Thomas, B.A., St. John's Coll., Cantab., Head Master of the School-frigate "Conway," 1, *Eldon-terrace, South Tranmere.*

Nov. 27, 1848 Dove, Percy Matthew, F.S.S., 1, *North John-street,* and 49, *Hamilton-square, Birkenhead.*

Jan. 23, 1848 Drysdale, John James, M.D. Edin., M.R.C.S. Ed., 44, *Rodney-street.*

Feb. 4, 1856 Duckworth, Henry, F.L.S., F.R.G.S., F.G.S., 5, *Cook-street,* and 2, *Gambier-terrace.*

Jan. 9, 1837 Duncan, William Henry, M.D. Edin., Medical Officer of Health, 2, *Cornwallis-street,* and 17, *Peel-terrace, Upper Canning-street.*

April 29, 1861 Eccles, Alex., B.A. Cantab., *Huyton.*

*Nov. 27, 1848 Edwards, John Baker, Ph.D. Gies., F.C.S., Lect. on Chemistry, Liverpool Royal Infirmary Sch. of Med., *Royal Institution Laboratory,* and 46, *Nelson-street.*

Dec. 15, 1856 England, Rev. James, M.A., 158, *Chatham street.*

Nov. 18, 1850 Evans, Henry Sugden, F.C.S., 52, *Hanover-street,* and 94, *Huskisson-street.*

April 30, 1860 Fabert, John Otto William, 1, *Parliament-street,* and 3, *St. James' Mount.*

*Dec. 14, 1846 Faram, John, 8, *Railway Cottages, Edge-hill,* and *Lime-street Railway-station.*

*Dec. 13, 1852 Ferguson, William, F.L.S., F.G.S., 62, *Gresham House, Old Broad-street, London, E.C.*

*April 3, 1837 Fletcher, Edward, 4, *India-buildings,* and 31, *High Park-street.*

Feb. 6, 1854 Fletcher, Fred. Dicker, M.R.C.S., Lect. on Anatomy and Physiology, Royal Infirmary Sch. of Med.; Surg. Workhouse Hospital; 15, *Upper Duke-street.*

*Mar. 19, 1855 Foard, James Thomas, 12, *Salisbury-street, Strand, London.*

*Feb. 6, 1854 Gee, Robert, M.D.Heidelb., M.R.C.P., M.R.C.S., Lect. on Patholog. Anat. Royal Infirmary Sch. of Med.; Physician Workhouse Hospital; 10, *Oxford-street.*

March 4, 1861 Ginsburg, Rev. C. D., 10, *Rake-lane.*

March 3, 1856 Grainger, John, B.A., 4, *Chapel-street*, and *Belfast.*

Nov. 14, 1853 Greenwood, Henry, 32, *Castle-st.*, and *Roseville, Huyton.*

Nov. 30, 1857 Grimmer, William Henry, 15, *Cable-st.*, and 64, *Grove-st.*

Jan. 22, 1855 Hakes, James, M.R.C.S., Surgeon to the Northern Hospital, 12, *Maryland-street.*

Nov. 30, 1857 Hall, Robert Henry, 16, *Hackin's Hey*, and *Sandfield House, Whiston.*

Oct. 18, 1858 Hamilton, Robert Gordon, 12, *Tithebarn-street*, and 99, *Bedford-street South.*

*Jan. 21, 1856 Hardman, Lawrence, *York-buildings, Sweeting-street*, and *Rock-park, Rock-ferry.*

Nov. 14, 1857 Hartley, John Bernard, *Coburg Dock*, and *Allerton.*

*Mar. 7, 1842 Heath, Edward, Esq., *Orange-court*, 37, *Castle-street*, and *St. Domingo-grove*, 114, *Breckfield-rd. N., Everton.*

Dec. 12, 1855 Hess, Ralph, *Albany, Oldhall-street*, and 17, *Upper Duke Street.*

Dec. 28, 1846 Higgins, Rev. H. H., M.A., Cantab., F.C.P.S., *Rainhill.*

*Oct. 31, 1836 Higginson, Alfred, M.R.C.S., Hon. Lect. on Anatomy, Liverpool Soc. of Fine Arts; Surg. Southern Hosp., 44, *Upper Parliament-street.*

Mar. 4, 1861 Hindley, Rev. H. J., M.A., 3, *Grecian-terrace, Everton.*

Jan. 12, 1857 Holden, E. Erasmus, *Appleton-in-Widnes, Warrington.*

Nov. 13, 1854 Holland, Charles, 17, *Tower-buildings North*, and 38, *Rodney-street.*

Mar. 22, 1847 Horner, Henry P., 10, *Basnett-street*, and 5, *Devonshire-road, Prince's-park.*

Nov. 4, 1850 Howson, Rev. John Saul, M.A. Trin. Col. Cantab. Principal of the Collegiate Institution, *Shaw-street*, and *Dingle-park, Dingle-lane.*

Dec. 27, 1841 Hume, Rev. Abrah., D.C.L. Dub., LL.D. Glas., F.S.A., 24, *Clarence-street, Everton.*
*Nov. 13, 1854 Hunter, John, Memb. Hist. Soc. Pennsylvania, *Herne, Charlotte-town, Prince Edward's Island.*
Jan. 26, 1857 Hutton, David, 3, *St. George's Crescent.*

*Apr. 29, 1850 Ihne, William, Ph.D.Bonn, 316, *Upper Parliament-st.*
Feb. 23, 1857 Imlach, Henry, M.D. Edin., 1, *Abercromby-square.*
*Oct. 21, 1844 Inman, Thomas, M.D. London, M.R.C.P., Phys. Royal Infirmary, 12, *Rodney-street,* and *Spital, Cheshire.*

Jan. 23, 1854 Jones, John, 28, *Chapel-street,* and 70, *Rodney-street.*
*April 4, 1852 Jones, Morris Charles, *Queen's Insurance-buildings,* and 75, *Shaw-street.*
May 5, 1851 Jones, Roger Lyon, *Liverpool and London Chambers, Exchange,* and 6, *Sunnyside, Prince's-Park.*

Nov. 26, 1860 Kenworthy, James, M.D., *Parkgate, Cheshire.*
Feb. 19, 1855 King, Alfred, 14, *Newington,* and 9, *Netherfield-rd. South.*
Oct. 29, 1860 Kirby, Frederick, *Falkner-st.,* and *Free Public Museum.*

Jan. 10, 1848 Lamport, William James, 21, *Water-street,* and 5, *Beech-terrace, Beech-street, Fairfield.*
*Jan. 14, 1839 Lassell, William, F.R.SS.L. and E., F.R.A.S., 27, *Milton-street,* and *Broadstones, Sandfield-park, West Derby.*
Oct. 21, 1844 Lear, John, 1, *North John-street,* and 22, *Holland-terrace, Duke-street, Edge Hill.*
Feb. 23, 1857 Lewis, James, *Liverpool and London Chambers, Exchange,* and 1, *Parkfield-road, Prince's-park.*
Dec. 10, 1860 Leyland, Joseph, *Williamson-square.*
Feb. 22, 1858 Little, Robert, *Liverpool and London Chambers, Exchange,* and *Rainhill.*

Oct. 20, 1859 M'Andrew, James Johnston, 5, *North John-street,* and *Greenfield Cottage, Bromborough.*
*Oct. 21, 1844 M'Andrew, Robert, F.R.S., F.L.S., *Allhallows-chambers, Lombard-street, London.*
March 9, 1857 MacFie, Robert Andrew, 30, *Moorfields,* and *Ashfield Hall, Neston.*
Dec. 11, 1854 M'Ilveen, Alexander, Principal Liverpool Institute, 9, *Sandon-terrace.*

Jan. 21, 1861 MacNaught, Rev. John, M.A., 63, *Everton-road.*

April 4, 1853 Marrat, Frederick Price, 22, *Arcade,* and 2, *Peverille-terrace, Edge-lane.*

Jan. 21, 1839 Martin, Studley, *Exchange chambers,* and 109, *Bedford-st.*

Feb. 5, 1844 Mayer, Joseph, F.S.A., F.R.A.S., F.E.S., 68, *Lord-street.*

April 1, 1861 Melly, George, 90, *Chatham-street.*

May 2, 1853 Milner, Rev. James Walker, M.A., 1, *Devonshire-terrace,* 324, *Upper Parliament-street.*

Oct. 31, 1859 Moore, Thomas John, Corr. Mem. Z.S., Curator Free Public Museum, *William Brown-street.*

Jan. 8, 1855 Morton, George Highfield, F.G.S., 9, *London-road.*

April 16, 1849 Moss, Rev. John James, B.A., *Upton, Cheshire.*

Oct. 29, 1850 Mott, Albert Julius, 19, *South Castle-street,* and *Holt-hill.*

April 3, 1854 Mott, Charles Grey, 27, *Argyle-street, Birkenhead,* and 2, *Shewell's-road, Holt-hill.*

Oct. 20, 1856 Nevins, John Birkbeck, M.D., Lond., M.R.C.S., Lect. on Materia Medica, Roy. Infirmary School of Medicine, 25, *Oxford-street.*

Dec. 15, 1851 Newlands, James, F.R.S.S.A., Borough Engineer, 2, *Cornwallis-street,* and 4, *Clare-terrace, Duke-st. North, Edge Hill.*

*Nov. 29, 1847 Nisbet, William, L.F.P.S.G., *Church-st., Egremont.*

*Oct. 15, 1855 North, Alfred, *Salcombe Hill, Sidmouth, Devonshire.*

Dec. 28, 1846 Picton, James Allanson, F.S.A., 11, *Dale-st.,* and *Sandyknowe, Wavertree.*

Feb. 6, 1854 Prange, F., *Royal Bank-buildings, Dale-street,* and 2, *Grove-park, Lodge-lane.*

Jan. 8, 1850 Ramsay, Rev. Arthur, M.A. Trin. Coll. Cantab., *Highfields, Eaton-road, West Derby.*

†Mar. 13, 1812 Rathbone, William, 20, *Water-street,* and *Greenbank, Wavertree.*

Nov. 12, 1860 Rathbone, Philip H., 4, *Water-street,* and *Greenbank-cottage, Wavertree.*

*Jan. 7, 1856 Rawlins, Charles Edward, Jun., 23, *Cable-street,* and 1, *Windermere-terrace, Prince's-park.*

*Nov. 17, 1851 Redish, Joseph Carter, 18, *Chapel-street,* and *Wavertree.*

Feb. 6, 1854 Rees, Wm., Poor-Law Auditor, *Old Trafford, Manchester.*

Mar. 20, 1854 Rigge, Thomas, 64, *Rodney-street.*

Nov. 2, 1840 Robberds, Rev. John, B.A., 58, *High Park-street.*

Oct. 18, 1858 Roberts, John, 25, *South John-street*, and *Pilgrim-street, Birkenhead.*

Jan. 21, 1861 Roberts, Henry Benjamin, *Parker-street.*

April 18, 1854 Rowe, James, 2, *Chapel-walks*, and 51, *Shaw-street.*

May 26, 1856 Samuelson, Newton, F.C.S., 3, *Hackin's-hey*, and 43, *Hope-street.*

April 6, 1846 Scholfield, Henry Daniel, M.D. Oxon, M.R.C.S., 14, *Hamilton-square, Birkenhead.*

†Mar. 13, 1812 Smith, James Houlbrooke, Esq., 28, *Rodney-street*, and *Green-hill, Allerton.*

Nov. 12, 1860 Spence, Charles, President of the Chatham Society, *Oldhall-street*, and 21, *Catharine-street.*

Dec. 14, 1857 Steele, Robert Topham, 4, *Water-street*, and 8, *Bedford-street South.*

Oct. 18, 1858 Stuart, Richard, 10, *Exchange-street East*, and *Brooklyn Villa, Breeze-hill, Walton.*

*Feb. 19, 1855 Taylor, John Stopford, M.D. Aberd., F.R.G.S., 1, *Springfield, St. Anne-street.*

Jan. 23, 1843 Taylor, Robert Hibbert, M.D. Edin., L.R.C.S. Ed. Lect. on Ophthalmic Medicine, Royal Infirmary School of Medicine, 1, *Percy street.*

Dec. 11, 1854 Thompson, Samuel H., Esq., *Thingwall Hall, Knotty Ash.*

Nov. 17, 1856 Tinling, Chas., 60, *Castle-st.*, and 17, *Clarence-st., Everton.*

Nov. 26, 1860 Tooke, William H., *Church-street*, and *Waterloo.*

Dec. 1, 1851 Towson, John Thomas, F.R.G.S., Scientific Examiner, Sailors' Home, 47, *Upper Parliament-street.*

*Feb. 19, 1844 Turnbull, James Muter, M.D. Edin., M.R.C.P., Phys. Royal Infirmary, 86, *Rodney-street.*

Nov. 16, 1857 Tymbas, Gregory, *York Buildings*, 14, *Dale-street*, and *Edge-lane Hall.*

Oct. 21, 1844 Vose, James Richard White, M.D. Edin., F.R.C.P., Phys. Royal Infirmary, 5, *Gambier-terrace.*

Oct. 29, 1860 Walker, David, M.D., F.L.S., F.R.G.S., M.R.I.A., late Surgeon and Naturalist to the "Fox," 8, *Beaufort-terrace, Seacombe.*

Mar. 18, 1861	Walker, Thomas Shadford, M.R.C.S., 54, *Rodney-street.*
Oct. 21, 1844	Walmsley, Joshua, 50, *Lord-street.*
Oct. 18, 1858	Watkins, John W., M.D., *Newton-in-the-Willows, near Warrington.*
Oct. 29, 1855	Wilks, William George, 1, *Dale-st.*, and *Mill-bank, Anfield.*
Mar. 18, 1861	Wood, Geo. S., *Belle-vue Road, Wavertree*, and 20, *Lord-st.*

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Nov. 6, 1812	Peter Mark Roget, M.D. Edin., F.R.C.P., F.R.S., F.G.S., F.R.A.S., F.R.G.S., &c., 18, *Upper Bedford-place, London.*
Feb. 2, 1815	George Cumming, M.D. Edin., M.R.C.P., *Denbigh.*
Feb. 12, 1819	John Stanley, M.D. Edin., *Whitehaven.*
Dec. 5, 1821	Rev. Brook Aspland, *Dukinfield, Cheshire.*
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Jan. 4, 1833	James Yates, M.A., F.R.S., F.L.S., F.G.S., &c., *Lauderdale House, Highgate, London.*
†April 12, 1833	Thomas Stewart Traill, M.D. Edin., F.R.C.P.E., F.R.S.E., F.G.S., &c., Professor of Medical Jurisprudence in Univer. Edin., *Edinburgh.*
†Jan. 2, 1835	John Ashton Yates, F.R.G.S., *Bryanston-square, London.*
Jan. 2, 1835	George Patten, A.R.A., 21, *Queen's-road West, Regent's-park, London.*
May 1, 1835	William Ewart, M.P., *Cambridge-square, Hyde-park, London.*
Nov. 2, 1835	The Right Hon. Lord Brougham and Vaux, M.A., D.C.L., F.R.S., Chancellor of the University of Edinburgh, 4, *Grafton-street, London, W.*, and *Brougham Hall, Penrith.*
Feb. 20, 1837	The Most Noble William, Duke of Devonshire, K.G., M.A., F.R.S., F.G.S., &c., *Devonshire House, London, W.*, and *Chatsworth, Derbyshire.*

Nov. 12, 1838	Geo. Biddell Airy, M.A., D.C.L., F.R.S., Hon. F.R.S.E., Hon. M.R.I.A., V.P.R.A.S., F.C.P.S., &c., Astronomer Royal, *Royal Observatory, Greenwich.*
Feb. 24, 1840	James Nasmyth, F.R.A.S., *Penshurst, Kent.*
Nov. 2, 1840	Richard Duncan Mackintosh, L.R.C.P., *Exeter.*
Nov. 15, 1841	Charles Bryce, M.D. Glasg., Fell.F.P.S.G., *Brighton.*
Oct. 21, 1844	J. Beete Jukes, M.A., F.R.S., M.R.I.A., F.G.S., Local Director of the Geological Survey of Ireland, 51, *Stephen's-green, Dublin.*
Oct. 21, 1844	T. P. Hall, *Coggeshall, Essex.*
Oct. 21, 1844	Peter Rylands, *Warrington.*
Oct. 21, 1844	John Scouler, M.D., LL.D., F.L.S., Prof. of Mineralogy, R.D.S., *Dublin.*
Oct. 21, 1844	Thomas Rymer Jones, F.R.S., F.Z.S., F.L.S., *King's College, London.*
Oct. 21, 1844	Robert Patterson, F.R.S., M.R.I.A., *Belfast.*
Oct. 21, 1844	Professor Alger, *Boston, U.S.*
Oct. 21, 1844	Sir Charles Lemon, Bart., M.A. Cantab., F.R.S., F.G.S., *Penrhyn, Cornwall.*
1844	William Carpenter, M.D. Edin., F.R.S., F.L.S., F.G.S., *Registrar London University.*
1847	Sir William Rowan Hamilton, LL.D., Hon. F.R.S.E., M.R.I.A., F.R.A.S., F.C.P.S., Astronomer Royal for Ireland, *Dublin.*
Nov. 26, 1848	Rev. Thomas Corser, M.A.., *Strand, Bury.*
Jan. 8, 1850	Rev. St. Vincent Beechy, M.A. Cantab., *Worsley, near Eccles.*
Jan. 27, 1851	James Smith, F.R.SS.L., and E., F.G.S., F.R.G.S., *Jordanhill, Glasgow.*
Feb. 24, 1851	Henry Clarke Pidgeon, *London.*
Feb. 24, 1851	Rev. Robert Bickersteth Mayor, M.A. Cantab., Fell. St. John's Coll. Cantab., F.C.P.S., *Rugby.*
Jan. 26, 1852	William Reynolds, M.D., *Coed-du, Denbighshire.*
Oct. 17, 1853	Rev. James Booth, LL.D., F.R.S., &c., *Stone, near Aylesbury.*
Feb. 23, 1857	Thomas Jos. Hutchinson, F.R.G.S., F.R.S.L., F.E.S., H.B.M. Consul, *Fernando Po.*
Oct. 15, 1860	William Brown, Lieut-Col. 5th L.A.V., *Richmond-hill, Liverpool.*

TREASURER'S ACCOUNTS, 1859-60.

Dr. *Literary and Philosophical Society, in Account with* Isaac Byerley, *Treasurer, to October*, 1860. Cr.

	£	s.	d.
To paid Greenwood—Printing "Proceedings"	59	5	2
" Tinling—Reporting	10	10	0
" Do. Printing	12	16	9
" Secretary—Editorial Expenses	10	10	0
" Do. Expenses of Management:— Delivery of Circulars, postage of Parcels, Letters, and Proceedings; Envelopes, general Stationery, and Incidentals......	16	3	0
" Do. Balance due at last Annual Meeting	2	2	6
" Expenses of Soireé;—Music, Door-keepers, Decorations, &c.	4	0	6
" Mrs. Johnson, for Tea, Coffee, Candles, &c., February 4th (including Soireé, Oct 31)..	7	2	8
" Do. Sept. 25th....................	6	7	8
" Share of Gas-fittings in Royal Institution..	9	8	8
" Collector's Commission, &c.	6	13	0
	£144	19	11
To Balance carried down..............	187	2	9
	£332	2	8

October, 1860. *Errors Excepted*,

Audited and found correct, Isaac Byerley, *Treasurer*.

Cuthbert Collingwood, }
Henry Duckworth, } Auditors.

	£	s.	d.	£	s.	d.
By Balance from last account:—						
" Dock Bond	£150	0	0			
" In Treasurer's hands	57	19	1			
				207	19	1
" Subscriptions (Annual)				87	3	0
" Do. (Arrears)				16	16	0
" Entrance Fees				4	4	0
" Interest on Dock Bond				5	16	4
" Cash in Bank				10	4	3
				£332	2	8
Balance brought down—						
Dock Bond	£150	0	0			
In Treasurer's hands	37	2	9			
Exclusive of Arrears	£187	2	9			

PROCEEDINGS

OF THE

LIVERPOOL

LITERARY AND PHILOSOPHICAL SOCIETY.

ANNUAL MEETING—FIFTIETH SESSION.

ROYAL INSTITUTION, October 1st, 1860.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The minutes of the last meeting having been read and signed,

Mr. REDISH, acting for the Secretary, read the following Report from the Council:—

"The Literary and Philosophical Society enters this evening upon its Fiftieth Session, but it does not complete its fiftieth year of existence until the 21st of February, 1862. It was founded in March, 1812, and thus held part of two Sessions in its first year. It will rest with the Society to celebrate this event at the proper time, by a suitable commemoration, should it be thought desirable. The work of the past Session has been for some time before the members, in a permanent form, and the Council refer with satisfaction to the volume of Proceedings, which will fairly maintain the claims of the Society as a body seeking to foster original inquiry and learned research. Considerable expense has been caused by the illustrations, but the Council feel that their value justified the outlay. The various donations which have been received during the past Session, have been acknowledged to their respective donors, and a complete list is printed in the volume already in the hands of the members.

"The attention of your Council having been drawn to *The Manchester Flora*, by Mr. L. H. Grindon, it was decided to present him with a bound copy of the Society's local Floras, which has accordingly been forwarded to the President of the Manchester School of Medicine, for that purpose.

"During the past year your Society has lost two ordinary members by death—Mr. King Ellison and Mr. J. M. Brighouse—and its distinguished corresponding member, the Rev. Professor Baden Powell. Its number has also been reduced to the extent of thirty by resignations (sixteen) and removals from the roll through the operation of the laws, but it has added nine new members to its ranks; consequently the numerical strength of the Society stands thus:—Ordinary members on the roll at last annual meeting, 150; added by election, 9; removals by death and other causes, 30. Present numbers:—Ordinary members, 129; corresponding members, 40; total, 169.

"The Treasurer's accounts will be laid before you, from which you will perceive that a considerable portion of the Society's funds remain invested on the security of a Dock Bond.

"Your Council desire to draw the attention of the Society to the following Report of the sub-committee of the learned societies, presented at a general meeting of the various councils, held in the Royal Institution, on the evening of the 26th of September:—'Your sub-committee appointed on the 9th of March last, in pursuance of a proposition of William Brown, Esq., to form a special museum for the exhibition of applications of practical science, have held numerous meetings, and have had communications with Mr. Brown, and with the Library and Museum Committee of the Town Council, and have much pleasure in reporting that their labours have resulted in an arrangement under which they hope that Mr. Brown's wishes will be fully realized, and that his munificence will result in a valuable addition to the public institutions of the town which was not contemplated when the building of the New Library and Museum was commenced. The Town Council have expressed their concurrence by a Resolution which places at your disposal a large space, comprising a ground floor and two galleries. It is as follows, and fully explains your position in regard to this movement:—

"'At a meeting of the Gardens and Library and Museum Committee, held on Friday, the 27th July, 1860 (present, Jas. A. Picton, Esq., chairman, &c.,) a suggestion having been made by Mr. Brown that a portion of the New Museum might be advantageously appropriated for the exhibition of new inventions and improvements of a scientific character, under the management of the learned societies of the town, and Mr. Brown having offered to take upon himself the expense of roofing and making galleries for such purpose, and correspondence and conferences having been held with deputations from the Architectural and Archæological Society, the Chemists' Asssociation, the Historic Society of Lancashire and Cheshire, the Literary and Philosophical Society, and the Polytechnic Society, with that view, the Library and Museum Committee recommend to the Council that a portion of the new building be set apart for the above-mentioned purpose, under the management of a committee of delegates from the above-named societies, who shall be permitted to remove such objects as they may deposit in pursuance of this resolution, such appropriation to continue during the pleasure of the Council, subject to such rules and regulations as the Council may determine upon from time to time. Extracted from the proceedings.—WM. SHUTTLEWORTH, Town-clerk. Approved by the Council, 1st August, 1860.—WM. SHUTTLEWORTH, Town-clerk.'

"It is hardly necessary for your Committee to point out that your retention of this valuable privilege is dependent upon your making such use of it as shall promote the public interests, and that the zealous labours of the Committee of Management, and of the societies will be required to this end. The meetings of the societies will afford opportunities for the elucidation of the objects exhibited, and much additional interest will be reflected upon their proceedings. The building is making rapid progress, and the portion appropriated to the purpose under consideration is expected to be ready about the end of the year. Your sub-committee recommend that the museum shall be called the 'Gallery of Inventions;' that the management of the Gallery of Inventions be vested in a committee, consisting of William Brown, Esq., the founder, and of twenty-five delegates, five to be annually appointed by each of the five societies. That an aggregate meeting of the members of the five societies shall be summoned by the Committee of Management in October of each year, and to them, and to the Library and Museum Committee of the Council, they shall report their proceedings. In conformity with the above, your Council recommend that the election of the five delegates from this Society shall take place this evening, and in future years at the annual meeting of the Society.

"In acknowledgment of Mr. Brown's munificent gift of a Free Public Library to the town, and his provision of a Gallery of Inventions, your Council recommend that he be elected a Corresponding Member of the Society, and that such laws be suspended as may be necessary, for this purpose.

"In conclusion, your Council recommend the following gentlemen for election on the new Council:—Richard Brooke, Esq., F.S.A., Charles H. Clark, Esq., William Ihne, Esq., Ph.D., Dadabhai Naoroji, Esq., James A. Picton, Esq., F.S.A.

"HENRY H. HIGGINS, M.A., *President.*

"ROYAL INSTITUTION, 1st Oct. 1860."

It was moved by the Rev. H. H. Higgins, and seconded by Mr. Byerley, "That the report now read be adopted." Carried unanimously.

The Treasurer's accounts, which had previously been audited by Dr. Collingwood, and Mr. Duckworth, were then submitted and passed.

The Society next proceeded to ballot for five new members of Council, when the following gentlemen, who were recommended by the retiring Council, were elected:—

Richard Brooke, F.S.A., William Ihne, Ph.D., James Allanson Picton, F.S.A., Prof. Dadabhai Naoroji, Charles H. Clark.

In addition to these, the following nine gentlemen were re-elected from the retiring Council:—

J. Baker Edwards, Ph.D., F.C.S., Isaac Byerley, F.L.S., F.R.C.S., Henry Duckworth, F.R.G.S., F.G.S., J. Birkbeck Nevins, M.D.Lond., C. Collingwood, M.B.Oxon, M.R.C.P., F.L.S., &c., Joseph Carter Redish, George Highfield Morton, F.G.S., David Purdie Thomson, M.D., Rev. J. Robberds, B.A.

A ballot was finally taken for the office-bearers, with the following result:—

President:

[The Rev. Henry H. Higgins, M.A.Cantab.]

Vice-Presidents:

J. Baker Edwards, Ph.D., F.C.S.

William Ihne, Ph.D.

James Allanson Picton, F.S.A.

Treasurer:

Isaac Byerley, F.L.S., F.R.C.S.

Hon. Secretary:

C. Collingwood, M.B.Oxon, M.R.C.P., F.L.S., &c.

It having been announced that William Brown, Esq., had expressed his intention to cover in a large area of the New

Museum, for the purpose of exhibiting therein models, inventions, and other objects of scientific interest; and, further, that he wished this "Gallery of Science and Inventions" to be under the direct management of a delegacy from the five learned societies, subject to the control of the Museum Committee of the Town Council, it was proposed by Dr. Edwards, and seconded by Mr. Byerley, "That five gentlemen be elected by ballot, as delegates from this Society, for the management of the proposed Gallery."

The following gentlemen were therefore elected:—Rev. H. H. Higgins, president, Dr. Collingwood, hon. sec., Dr. Nevins, Mr. A. Higginson, and Mr. H. Duckworth.

The following recommendation from the Council was then entertained:—"That in consideration of the munificent gift of the Free Public Library to the town, it is desirable to elect William Brown, Esq., a Corresponding Member of this Society; and the suspension of such laws as may be necessary, for this purpose."

It was therefore moved by Mr. Nisbet, and seconded by Dr. Edwards, "That Laws 7, 10, and 11 be suspended, so far as they would interfere with the election of William Brown, Esq., as a Corresponding Member of this Society." This resolution was carried unanimously.

It was further moved by Mr. Higginson, and seconded by Dr. Nevins, "That William Brown, Esq., be elected a Corresponding Member of this Society." A ballot was then taken, when Mr. William Brown was unanimously elected a Corresponding Member. These proceedings to be confirmed at an Extraordinary Meeting of the Society, to be held on the 15th instant.

FIRST ORDINARY MEETING,

ROYAL INSTITUTION, October 15th, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The **PRESIDENT** drew the attention of the Society to the Liverpool Field Naturalists' Club, which had sprung into existence since the last ordinary meeting, and had already become an important and flourishing body. He referred to the interesting excursions which had been conducted by them during the summer, and announced that the first evening meeting of the Club would be held at the Royal Institution, on Monday evening next, when Dr. Dickinson would preside, and Dr. Collingwood, one of the Vice-Presidents, would deliver a lecture on "Marine Zoology."

Dr. **IHNE** referred to an investigation which had lately been made by M. Lorentz, of Vienna, as to the authenticity of the story of Arnold von Winkelried. He remarked that it has long been admitted on all sides that the story of William Tell is entirely fabulous. It now appears that another Swiss hero has to be removed from the region of history into that of fable. The Battle of Sempach was fought A.D. 1386, against Duke Leopold of Austria, and is said to have been decided in favour of the Swiss by the self-devotion of Arnold von Winkelried, who rushed upon the line of Austrian lances, and, burying as many as he could grasp in his own breast, made a passage for his countrymen. M. O. Lorentz, of Vienna, in a recent publication, shows that the oldest records of the battle of Sempach make no mention of Winkelried. Nor is he named in two very old popular songs, or by the historians Justinger, Russ, and Etterlin. He is likewise ignored by the chronicles of Constance, which date from the beginning of the fifteenth century, and by a MS. Swiss history of the sixteenth century. He is first mentioned in the chronicle of Tchudi, (died 1572,) who draws the story from a popular song. Now this song, as M. Lorentz shows, is not an original, but an expanded version of a song given in Russ's chronicles, and containing no mention whatever of Winkelried, though Russ says it was sung as a song of victory after the battle of Sempach. The destruction of this and similar fables was the duty, though not an agreeable one, of the truthful and accurate historian.

Mr. NISBET exhibited the head and palatal teeth of a species of Parrot-fish, of the genus *Scarus*, (Linn.,) belonging to the hard-finned family *Labridæ* of Cuvier. This curious head was found in the guano at Halabi, one of the Kooria Mooria Islands.

Additions to the local Flora and Fauna having been called for, according to custom, the Secretary submitted a list, furnished by Messrs. F. M. WEBB and H. FISHER, containing notices of many new habitats of interesting plants, as follows:—

RANUNCULUS LENORMANDI.—Frequent about Claughton Village. F. M. W.

RANUNCULUS LINGUA, L.—Ditch behind Pym's Buildings, Oxton-heath. H. F.; and marshy ground between Hoylake and West Kirby. F. M. W. and H. F.

RANUNCULUS AURICOMUS.—Prenton. H. F. and F. P. Marrat.

RANUNCULUS PARVIFLORUS, L.—Left hand side of Upton Road after passing the cutting. F. P. Marrat and H. F.

RANUNCULUS ARVENSIS, L.—Corn field, West Derby. H. F.

Aquilegia vulgaris, L.—Bromborough Wood. W. H. Hatcher and H. H. Higgins.

Lepidium Smithii, Hook.—Field between Higher Tranmere and Bebbington; also in a yard off Noctorum Farm, on a bank. F. M. W.

Erysimum cheiranthoides, L.—Cultivated ground, Old Swan. C. S. Gregson. Very sparingly near Sutton. F. M. W.

Sinapis (Diplotaxis) tenuifolia, Br.—South west corner of Birkenhead Park, by old house. The original plants have been destroyed (in September), but not until a portion of the seed had ripened, and, I believe, fallen, so that the plant may again make its appearance in this locality. F. M. W.

Reseda fruticulosa.—Bootle, near the Rimrose. H. F.

Viola palustris, L.—Piece of marshy ground on left hand side of the road running from Upton Road to Dock Cottage Church—plentiful and fine. F. M. W. Raby. H. H. H.

Drosera intermedia, var. coalescens.—Frankby Heath. F. M. W. and H. F.

Silene anglica, L—Very abundant in a rye-field, through which the pathway from Hoylake to West Kirby passes. F. M. W. and H. F.

Sagina subulata.—Frankby Heath. H. F. and F. M. W.

Spergularia media (var. of S. marina.)—Shore near Dingle.

Linum usitatissimum, L.—Rubbish heaps, Canning Street, Birkenhead. F. M. W.

Linum perenne.—Between Heswall and Caldy. H. F. and F. M. W.

Coronopus didyma.—Speke. W. Hitchmough.

Fumaria capreolata, var. pallidiflora.—Hedge near Poolton. H. F. and F. M. W.

Saponaria officinalis.—Wall near Prenton Hall. H. F. and F. P. M. Railway banks near Hightown Station. H. F. and F. M. W.

Viola odorata.—Near Upton Village on road to Moreton. Miss Cooke.

Hypericum elodes.—Side of a large pit on Oxton Heath, above Noctorum Farm, July, 1858. F. M. W. and Dr. Collingwood.

Geranium columbinum.—Near Queen's Ferry. H. F.

Impatiens Noli-me-tangere.—Mount's Wood, near Prenton. Mr. Price. Lane at Oxton. Mr. Price and Dr. Wright.

Genista anglica.—Left hand side of lane from Hale road to shore by Dungeon. F. M. W. Near Barnstone. H. F. and F. M. W.

Medicago denticulata.—A single plant by side of Upton road, near Claughton Village, July, 1859. F. M. W.

Melilotus arvensis.—Seaforth. H. F. By Bromborough Pool Candle Works. Mr. Hatcher. On a piece of waste ground by railway crossing Birkenhead Docks. F. M. W.

Melilotus vulgaris.—Macadamized road, Claughton, 1858. H. F. Together with the last by Birkenhead Docks. F. M. W.

Ornithopus compressus.—A south of Europe plant, with the above on ballast heaps, Birkenhead Docks. H. F. and F. M. W.

Trifolium hybridum.—Crosby sand-hills. H. F. Near Arrow Brook, Cheshire. F. M. W. and H. F., and near Knotty Ash. H. F. (Sown in some places as fodder, and escaped from cultivation.)

Trifolium striatum.—Plentiful by road side, near Arrow Brook, Cheshire. H. F. and F. M. W. A single plant at top of Back Lane, at Wallasey, 1858. F. M. W. Rainhill. H. H. H.

Trifolium pratense.—*White flowered* var., near Hoylake. B. Cooke. Plentiful in a field in Ness. F. M. W.

Trifolium repens.—Proliferous variety, common.

Lotus corniculatus, var. tenuis.—Moist piece of ground near Huyton Quarry. F. M. W.

Agrimonia odorata.—Brought by herbalists to market from Southport. H. F.

Potentilla argentea.—Shrewsbury road, Claughton Village, a single plant. F. M. W.

Rosa Sabini.—Small heath near Bebington Station. F. M. W. and H. F.

Rosa villosa.—Is a common plant in Cheshire.

Rosa tomentosa.—Near Mollington. H. F.

Œnothera biennis.—Near Leasowe Castle. F. M. W.

Myriophyllum alternifolium.—Pond near New Brighton. H. F.

Ceratophyllum demersum.—Plentiful in ditch at Bidston Marsh. F. M. W.

Bryonia dioica.—Hedge, Ditton Marsh. W. Hitchmough.

Cotyledon Umbilicus.—Plentiful and fine on walls about Noctorum Farm. F. M. W.

Cicuta virosa.—Abundant in a pond at Ellesmere. Mr. Bennett.

Ægopodium Podagraria.—Abundant in a small plantation opposite lodge to residence of W. Jackson, Esq., M. P., Claughton. F. M. W.

Œnanthe Lachenalii.—Ditches near Leasowe Lighthouse. F. M. W.

Œnanthe Phellandrium.—Lane from Hale road to Old Hut, in a pit on left hand side. F. M. W.

Conium maculatum.—Plentiful at Ellesmere Port. Mr. Bennett.

Fedia dentata.—Field near Woodchurch, again near Ness, and in other places. F. M. W.

Carduus acanthoides.—Road side before coming into Hoylake.—H. F. and F. M. W.

Carduus Marianus.—Waste ground near warehouses, Birkenhead. H. F. (Outcast.)

Centaurea Calcitrapa.—Near the railway crossing Birkenhead Docks, 1858 (at present there ?); probably, in this instance, a ballast plant.

Convolvulus Soldanella.—Shore below Dee Inn, West Kirby. F. P. Marrat and I. Byerley.

Symphytum officinale.—Plentiful at Ellesmere Port. Mr. Bennett.

Melampyrum pratense, var. montanum.—Hills in the neighbourhood of Frodsham. Miss Johnson.

Pedicularis palustris.—*White flowered* variety, moist ground below Flaybrick Hill. Very sparingly. F. M. W.

Limosella aquatica.—Margin of Raby mere. H. F.

Orobanche minor.—Speke, on clover. W. Hitchmough. Clover field, Litherland Moss. H. F.

Origanum vulgare.—Near Hightown Station. H. F. and F. M. W. (Outcast.)

Scutellaria minor.—Ditch on Thurstaston Hill in direction of Irby Windmill. F. M. W. and H. F. Marshy piece of ground at commencement of Bidston Heath.

Nepeta cataria.—Near Mollington, plentiful. H. F.

Lamium maculatum.—Occurs in several localities, but always as an outcast.

Littorella lacustris.—Abundant on Frankby mere. H. F. and F. M. W.

Polygonum Bistorta.—Field by side of West Park road, Claughton. F. M. W.

Euphorbia Lathyris.—Corn field, Sankey Green. C. S. Gregson.

Gymnadenia conopsea.—Field by which the pathway from Hoylake to West Kirby passes. H. F. and F. M. W.

Convallaria majalis.—Fir plantation between Egremont and New Brighton. H. F.

Allium vineale.—Hale. C. S. Gregson.

Arum maculatum.—Prenton Wood. H. F. and F. P. Marrat; and about Noctorum and Woodchurch. F. M. W.

Acorus Calamus.—Plentiful at Ellesmere Port. Mr. Bennett.

Potamogeton oblongus.—Margin of a pit on Oxton Heath. F. M. W. (Will probably prove frequent.)

Eleocharis uniglumis.—Sevenpits, Aintree. H. F.

Poa rigida.—Plentiful on shore below Heswall.

Botrychium Lunaria.—Very fine in a field behind Mr. Curry's house, at Claughton Village, and occurs sparingly on a heathy piece of ground by side of Upton Road, a little past Claughton Village. F. M. W.

Pilularia globulifera.—Pit on Oxton Heath, above Noctorum Farm. F. M. W. and H. F.

Lycopodium inundatum.—Moist places, Oxton Heath, where the turf has been cut. F. M. W.

Lycopodium Selago.—Heswall Hill, (sparingly.) H. F. and F. M. W.

Dr. Collingwood also submitted the following list of rare plants and new habitats, discovered in his excursions with his Botanical Class, during the summer session of 1860:—

Ranunculus Lingua.—Raby.
Lepidium latifolium.—Crosby.
Malva moschata.—Raby.
Geranium sanguineum.—Caldy.
Helosciadium inundatum.—Wallasey Marsh.
Campanula latifolia.—Hale.
Gentiana Pneumonanthe.—Raby.
Convolvulus Soldanella.—New Brighton Sand-hills.
Veronica montana.—Ainsdale.
Pinguicula vulgaris.—Raby.
Parietaria officinalis.—Crosby.
Habenaria bifolia.—Simonswood Moss.
Ophrys apifera.—Crosby.
Colchicum autumnale.—
Lycopodium clavatum.—Storeton.
Lycopodium inundatum.—Hale.
Anacharis alsinastrum.—Rock Ferry.

Mr. F. P. Marrat submitted the following list of Mosses from new localities, several of which were gathered during the excursions of the Naturalists' Field Club:—

Gymnostomum tenue, Schrad.—(Slender beardless moss.) Wils. T. 7.

On the wall supporting the north bank of the railway between Huyton Gate and Huyton Quarry. F. P. M.

Desmatodon nervosus, Br. and Schrad.—(Thick-ribbed Desmatodon.) Wils. T. 20.

On a wall at West Kirby, fruit young in November. New to this district. F. P. M.

Hedwigia ciliata, Hed.—(Hoary branched beardless moss.) Wils. T. 6.

On the wall between Bromborough Village and the stile road leading to Eastham Ferry, The plant is now growing here, October, 1860.

Racomitrium aciculare, Brid.—(Dark mountain fringe moss.) Wils. T. 19.

On a dry wall between Hooton Station and Willaston, in company with Hed. ciliata. A very strange locality for a water moss. New to this district. F. P. M.

Orthotrichum stramineum, Harnsch.—(Straw coloured bristle moss.) Wils. T. 45.

On trees near the stream between Bromborough Station and Raby, rare. New to this district. F. P. M.

Orthotrichum tenellum. Bruch.—(Slender-fruited bristle moss.) Wils. T. 45.

On a prostrate poplar near Hightown. F. P. M.

Orthotrichum Sprucei, Mont.—(Spruce's bristle moss.) Wils. T. 45.

With O. stramineum as above.

Polytrichum formosum, Hed.—(Buff-fruited hair moss.) Wils. T. 46.

Eastham Wood, June, in fine fruit. New to the district. F. P. M.

Bryum neodamense, Itzigsohn.—(New thread moss.)

In a pond called the Bullrush Slack, Ainsdale. This is the moss named Bryum formosum by Wilson and Marrat, and is considered a water variety of Bryum pseudo-triquetrum by Dr. Schimper in his new synopsis. Such, however, I cannot regard it. In its cucullate and deflexed leaves it differs from every form of that moss, and also from the water variety of B. psuedo-triquetrum growing in a pond a short distance from this station.

Bryum uliginosum, Br. and Sch.—(Bog thread moss.) Wils. T. 48.

On a wall near the bridge crossing Bromborough Pool. F. P. M. No notice of this species growing on walls has hitherto been recorded.

Bryum lacustre, Bland.—(Small round-fruited thread moss.) Wils. T. 48.

In some marshy ground in the brickfield behind Huyton Quarry, August 26th, 1860. F. P. M. This was the first time the moss had been gathered for nearly fifty years. On my next visit to this locality I found to my great dismay, the place as level as a turnpike road, and not more productive, having been filled with rubbish from Huyton Quarry. On the 30th of August, Mr. Wilson found it again at Ainsdale, and on the 15th of September Mr. W. and myself gathered it in considerable plenty between Birkdale and Ainsdale. Its time of fruiting is therefore not May and June, but September and October.

Bryum obconicum, Harnsch.—(Obconical thread moss.) Wils. T. 49.

On the wall supporting the north bank of the railway between Huyton Gate and Huyton Quarry, August 26th. Very rare. F. P. M.

Bartramia calcarea, Br. and Sch.—(Thick-necked apple moss.) Wils. T. 52.

In the Pinguicula bog at Raby. F. P. M. New to the district. Rare.

Leucodon sciuroides, Schwaegr.—(Squirrel-tail fork moss.)

On a tree near Bromborough Station. F. P. M.

Hypnum giganteum, Schimp.—(Gigantic feather moss.) Schimper's Synopsis, page 642.

This is my variety of H. cordifolium mentioned in the list in 1855, and then regarded as a form of that moss. Recent investigation has proved it to be diœcious, hence the necessity for the new name.

Hypnum stenophyllum, Wils. MSS.—(Slender-leaved thread moss.)

Dr. Schimper has erroneously placed this as a variety of H. fluitans. I formerly made the same mistake. It is diœcious, and a variety of H. exannulatum, of Br. and Sch., the H. aduncum of Wilson.

HEPATIC.

Petalophyllum Ralfsii, Wils.—E. B. Sup. T. 2874.

Ainsdale. William Wilson, Esq.

LICHEN.

Lecanora carneo-lutea, Ach.

On a wall of Mr. Gladstone's, between Broad Green and Roby. New to the district. F. P. M.

The additions to the Fauna were postponed till the next meeting.

The following paper was then read—

ON THE BIRDS WHICH NEST IN THE DISTRICT.

(PART II.)

By J. FITZHERBERT BROCKHOLES, Esq.

It will be remembered that the former portion of this paper (Proceedings, 1859-60, p. 115) treated of the land birds which nest in the district of Liverpool as far as the end of the Fringillidæ, following the classification used by Yarrell. To these must be added another species which I discovered last spring,* together with some further remarks concerning birds already mentioned. This additional matter will form a supplement at the end of the present paper, which is intended to notice the remainder.

The Starling *(Sturnus vulgaris)* deserves all patronage, as well for its social, interesting, and often confiding habits, as for its utility. It is blamed for stealing the eggs or small young of dovecote pigeons; but, I think, undeservedly—the mischief is more probably due to rats. The Starling's food consists mainly, if not entirely, of worms, grubs, &c., and the bird is, therefore, the farmer's friend. Flocks may be seen almost throughout the year frequenting grass lands in search of food, either alone or in company with rooks, lapwings, &c. There is nothing particular about the song, though, probably, most people like to hear it from their chimney top. The flight is peculiar, and consists of a series of long plunges, directed upwards, downwards, or sideways, but always tending to an onward course. It is maintained with greater rapidity and violence than that of almost any other bird. The nest, composed of hay or straw, lined with the softer portions, is simple and unpretending. It is placed in a chimney, a spout, or dovecot, in a hole in a wall or tree, and sometimes in or about the nest of a rook, crow, or magpie, even though this be tenanted by its rightful occupants. The eggs, five in number, are pale blue.

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* The bird referred to is the Garden-warbler (*Curruca hortensis*), which was first remarked by Dr. Collingwood in the spring of 1858, and is recorded in the "Proceedings" for 1858-59, p. 10.—Ed.

A pair of Ravens *(Corvus corax)* built their nest at Hilbre two or three years ago, but were driven away before the young were hatched, by boys who threw stones at them. The nest, similar to that of a crow, was placed in a niche in the rock on the western side of the middle Island. Their eggs, also, resemble those of the crow, but are usually larger.

The Crow *(Corvus corone)* is resident; it occurs sparingly in the district, and nests occasionally in the more retired woods. This species is not gregarious, though sometimes many may meet in a favourite roosting place, or other spot where there is some attraction. The nest, composed of sticks covered with mud, and lined internally with fibres, is placed in a tree. There is seldom a second in the same wood, though occasionally, several may occur in one vicinity. In one remarkable instance, I saw three in the same tree. The eggs, four to six in number, are greenish gray, variously marked with dark gray, olive green, and dull black.

The resident Jackdaw *(Corvus monedula)* is sufficiently common, and is much more social than the two preceding species. It not only congregates with others of its kind, but is partial to the society of rooks and starlings. It is a lively, noisy bird, but the note is much more mellow and pleasing than that of its congeners. The nest, composed of sticks, lined with fibres, wool, &c., is placed in a church tower, ruin, or chimney; in a niche or hole in a rock, and sometimes in a rookery. The eggs, four or five in number, are greenish white, freckled or spotted with two or three shades of gray, olive brown, or dull black; but they vary considerably.

The Rook *(Corvus frugilegus)* is well known, but unfortunately little understood by farmers, who kill so many by poisoning their seeds. Few birds are more useful to the agriculturist, and few do less harm. The system of poisoning seeds ought to be strongly discountenanced, especially as it endangers and sometimes destroys more than is intended. Instances, I believe, have occurred where pigs and other stock have died through eating a poisoned carcase. The Rook, it is well known, builds in societies, and constructs its nest of sticks, covered with mud, and lined internally with fibres. The eggs, four to six, are green or greenish white, suffused, speckled, spotted or blotched with olive brown, or dull black. They are very variable.

The Magpie *(Pica caudata)* is sufficiently abundant throughout the wooded parts of the district. Game preservers destroy it on account of its thievish, egg-loving propensities, so that it will be less frequent on preserved parts than on others. Though too frequently disliked and persecuted, this wary bird has considerable interest for the ornithologist, on account of its versatile habits, cunning and capabilities. It is not gregarious, though sometimes a family may be seen together. In early spring, it is not uncommon to find from twelve to thirty associated; but these do not remain long together, and have probably met for the purpose of pairing. In the summer months, magpies use notes which are very different from their well-known ordinary harsh one. These are produced in a subdued key, often mellow and pleasing, and sometimes puzzle the experienced to know their author. The domed nest, composed of sticks, covered with mud, and lined internally with fibres, is placed at various elevations in a tree or bush. The birds frequently build it in a spot difficult of access; but, strangely enough, they constantly choose the most exposed situations for their earliest nests. Those built in March, or early in April, are placed in isolated trees or bushes, or in narrow plantations where they are exposed to all weathers, and to the view of everything for a long distance. When the foliage is expanding, the later nests are built in larger woods, and the hand can scarcely be inserted without receiving scratches. The eggs, six to eight in number, are very variable. Typical ones are greenish gray, freckled or spotted all over with two or three darker shades, and olive brown.

The Jay *(Garrulus glandarius)* is resident in most large woods. In common with the crow and magpie, it is persecuted for its thievish, egg-sucking propensities, though extreme wariness, and more retired habits, enable it to maintain existence where others fail. Scarcely is an enemy within sight when the harsh note of the Jay gives the alarm, and all the tribe fly off. In the summer months, when there is abundant shelter, other notes are used. These are varied, subdued, and sometimes mellow—so much so, that on one occasion I heard them blended and prolonged into a pleasant warble. In addition to its own ordinary notes, the Jay will imitate those of other birds, sometimes sufficiently well to deceive. I have heard it produce the quail's note in a rather rough, loud key; and on several occasions I have been puzzled to detect its imitation of that of the crow. The nest, composed of sticks and roots, lined with fibres, is placed at various elevations in a tree or bush. The eggs are grayish brown, freckled or mottled all over with a darker shade; they are usually five in number.

The greater spotted Woodpecker *(Picus major)* is an occasional visitor. A pair nested in Bromborough Wood last spring. The hole in which the young were reared was freshly made in a dead part of the oak immediately below where a brood of goat-moth larvæ *(Cossus ligniperda)* had been. It passed horizontally through the bole for three or four inches, and then descended in a rather oblique direction for about a foot. The entrance was only large enough to admit the birds singly, but the hole was rather larger towards the bottom.

The chippings were not conveyed away, but remained underneath just as they had happened to fall. The entrance to the hole was at an elevation of about twelve feet. The eggs are glossy white. The female was bold and pugnacious while on the nest; on placing a stick in the entrance to prevent egress, she scrambled up, bit it angrily, and in so doing produced a gnawing sound somewhat similar to that made by mice. The male, on the contrary, quietly awaited an opportunity to escape. The birds occasionally resorted to the ground, probably in search of insects.

The common Creeper *(Certhia familiaris)* resides in the district, though in smaller numbers than formerly. It is highly interesting to watch these birds in search of insects; and nothing can exceed their graceful movements whilst running on the trees. No position seems amiss to them, and they walk with equal ease up, down, or round a tree or branch, or hang with the head downward for an indefinite length of time. Should they stop, whilst ascending, to pick an insect from a crevice, or from under the bark, they place the tail against the bole, as do the woodpeckers, and use it as a means of support. The noise produced by pecking against the tree is sometimes loud, considering the size of the bird, and may be heard at a moderate distance. Whilst looking for insects, the Creeper will occasionally dislodge pieces of bark of the size of large nuts, which shows considerable strength. The nest is placed behind loose bark, detached ivy, or in a hole in a tree. I have known one in a hole in a wall, and another on the part of a tree trunk where a large branch had been abruptly broken away. I have not seen one for some time, and do not remember the materials used. The eggs are white, spotted with reddish brown.

The Wren *(Troglodytes vulgaris)* is a well-known resident, and one which invariably sings throughout the year. Though loud, the song is lively, clear, and pleasing. In habits, the

Wren is restless and active, bold and fearless, frequenting woods, hedge-rows, isolated bushes, banks, and open commons, especially those parts where there is shelter amongst rough herbage. It creeps quickly and mouse-like through bushes, hollow banks, and over the surface of the ground, and indulges frequently in short flights. In winter, this bird, though so small, feeds extensively on snails, extracting them from the shells in an ingenious manner. When a snail is found, it is conveyed to a selected stone, and tapped upon until the shell breaks, or the animal otherwise becomes detached. It is then easily taken out and devoured. The same stone will often be resorted to for a long time, so that a considerable number of shells will frequently be accumulated. These remains may often be noticed, and as often, perhaps, have puzzled the beholder. In winter, also, Wrens collect in numbers in warm favourite roosting places. At dusk, the observer, by remaining quiet, may see them coming singly from all directions to a favourite hay-stack. On arrival, they locate themselves in holes previously made round the sides by their own species, or other small birds. By going after dark, the observer may sometimes take them by the dozen in a handful from one hole. Old or unfinished nests are often chosen as dormitories, and sometimes unlined ones are built expressly for the purpose. The sites selected for these, and those required as cradles for their young, are as varied as the haunts: low branches of trees, sprays growing from the boles, bare roots of trees under hollow banks, holes in walls, banks or hay-stacks are the most common. I have known the nest at an elevation of about fifteen feet, but such instances are rare. Great skill is shown in adapting it to circumstances, and the materials used in the construction differ according to the situation. Composed generally of that which abounds in the neighbourhood, it resembles more or less closely the objects which are near. If in a bank, for instance, it is composed chiefly of moss; when in a wall or stack, hay is the principal material; and dead leaves are often the main component of those in trees and bushes. It is domed, and has the entrance on one side. The eggs, which are white, dotted or spotted with reddish brown, are numerous, and commonly seven in number.

The Cuckoo (*Cuculus canorus*). This favourite and common summer visitor, although apparently without affection for its offspring, is strongly attached to its mate. Wherever the one bird is, the other is seldom far off. It is well known that the eggs are placed in the nests of other birds, and that the parental duties devolve upon these. The nests of the various insectivorous species, as well as those of larks, buntings, and finches, are chosen, though preference seems to be given in this district to the nests of the meadow-pipit, and sky-lark. Strangely enough, I have never yet seen the egg of a Cuckoo in the nest of the hedge-sparrow. It is, probably, a rare occurrence for the Cuckoo to select a sparrow's nest when built in a wall, yet I have known such an instance. When a boy, I saw a Cuckoo enter a moderately large oval hole in the wall of a hay-loft—one of those ordinarily left in farm buildings to admit air—and which contained a sparrow's nest The purpose of the stranger's visit occurred to me, and on climbing up soon afterwards, I found a Cuckoo's egg amongst the legitimate ones. Cuckoo's eggs are small, compared with the size of the bird, and are very variable. They are pale, or dark gray, often reddish, brown, or olive, dotted, spotted, and sometimes blotched with darker shades. Occasionally, two are found in the same nest, but more frequently only one. It is highly probable that the Cuckoo deposits several.

The Kingfisher (*Alcedo ispida*) is resident, though in decreasing numbers, owing, no doubt, to the too frequent desire of obtaining so beautiful a bird. It is an interesting sight to watch it catch its prey. Perched, motionless, on a projecting stone, or overhanging bank or branch, it suddenly plunges at a passing fish, and instantly reappears; or stopping its rapid, onward flight, it hovers for a moment over the stream, and swiftly darts into the water, seldom missing the fish, though rarely seen to swallow it. The impetus with which the plunges are made must be very great, as the bird is far too buoyant to sink in water without the application of considerable force. The nest is composed of the indigestible portions of fish, and is placed some distance within a hole in a dry bank. The eggs are glossy white.

The Swallow (*Hirundo rustica*), also an annual summer visitor, appears in greater or less numbers, on or about the 23rd of April. The nest, composed of mud, mixed with hay, and lined internally with feathers, is placed on a ledge in a chimney, or against a beam in a farm building or outhouse, and sometimes against a rafter supporting a bridge. It is never domed; neither is it ever attached by the rim to any ceiling, &c. An unusual form of nest, built in a tree at Maghull, has come within my notice. It was composed of the ordinary materials, but formed, like a chaffinch's, amongst twigs: such instances are rare. The eggs, five in number, are white, dotted, or spotted with reddish brown.

The Martin (*Hirundo urbica*) arrives annually, in considerable numbers, to spend the summer with us. The nest, composed of mud, mixed with hay, and lined internally with feathers, is placed against a beam in an outhouse, or wall, or under the eaves of a building, or bridge. It is almost always domed, or attached by the rim to a ceiling, or the lower part of another nest, &c. The Martin often builds in societies. The eggs are white, and five form the complement.

The Sand-Martin (*Hirundo riparia*) generally arrives with the swallow in each year, and is, perhaps, the most abundant hirundine which visits the district. It is a social bird, and colonies of varying extent take possession of suitable banks in quarry sides, &c., for the purposes of nidification. Each pair makes a separate hole, which is sometimes three or four feet in length, and serves, unless disturbed, for several seasons. The nest, composed of hay, lined with feathers, is built in an enlargement, at a distance of half a yard or more from the entrance. The eggs, five in number, are white.

Sometimes large flights of Swallows, Martins, and Sand-Martins arrive in company; and at others, any two of the species will come together. The higher end of Wallasey Pool, on the side of Bidston Marsh, is a favourite resort on their first arrival; and before they disperse, they may sometimes be seen so tired as scarcely to be able to fly. Previous to their departure, they congregate in similar flocks in the same neighbourhood, and roost amongst the adjacent reeds.

The Swift (*Cypselus apus*), an annual summer visitor, is one of the last to arrive, and the latest to commence nidification. Nests which I have known have been appropriated from the sparrow, and have contained young in the middle of July. They are often difficult to reach, owing to their being placed within serpentine holes in walls and Church towers. The eggs are white, and long in proportion to their breadth.

The Nightjar (*Caprimulgus Europæus*) annually visits the firwoods on the Cheshire side to spend the summer. Formerly, the species was much more abundant in the vicinity of Birkenhead than at present; but the numbers which nest there are yearly decreasing, owing to the increase of persons who shoot them. It would be a pity were so useful, interesting, and harmless a bird to be annihilated in the district. Their graceful evolutions performed in the evening twilight, whilst hawking for the insects which form their sole food, are well worth watching; and the twice-repeated sharp note used when on the wing is sometimes rather startling. What may be termed the song is uttered from a perch, and resembles the croaking of natterjack toads. The eggs, two in number, are white, spotted, blotched, or marbled over with black, leaden gray, or various shades of brown. They are laid upon the bare ground, or on an accumulation of decaying vegetable matter. No nest is formed.

The wary, shy, and retiring Ring Dove (*Columba palumbus*) is an abundant resident throughout the wooded parts of the district. Its meagre, almost flat nest, composed of sticks and fibres, is placed at various elevations in a tree or bush. I have known of one built on a large accumulation of dead leaves, &c., which remained in a tree. It is strange that the magpies, which had a nest in the adjoining fir, left it undisturbed. The eggs, two in number, are white; three or four broods are reared in the year.

The Stock Dove (*Columba œnas*) frequents the haunts of the preceding bird, but is less plentiful. It breeds here, and is probably resident. The nest, similar to the one last described, is sometimes built in a spruce or other evergreen fir, and more frequently in ivy. The eggs, two in number, are white. The feathers of these two species are very slightly attached to the skin, and consequently come off easily. Both birds will fly long distances to salt, vetches, or other favourite delicacy.

A pair of Rock Doves (*Columba livia*) frequented the high portion of the river's bank between Eastham Ferry and Hooton during the spring, three or four years ago, and no doubt nested there.

The Turtle Dove (*Columba turtur*) occasionally visits the district, and, being a summer migrant, may sometimes nest here.

The Pheasant (*Phasianus colchicus*) scarcely needs a comment. During incubation the female sits very closely—so much so that even the wild birds will not stir though an intruder almost steps upon them. The nest, composed of leaves, dry grass, &c., is frequently made amongst dead herbage, which, accords well with the sober plumage of the hen, and helps to conceal her from her enemies. A close and practised observer will sometimes walk over without seeing her. The hen will occasionally cover her eggs with leaves, &c., on leaving her nest. The pheasant is polygamous; the eggs, nine to fifteen in number, are brown or greenish brown.

I am informed that there are Red Grouse (*Lagopus scoticus*) on Simonswood Moss, and that the bird is constantly within the ten miles' circle. The eggs are brownish buff or reddish gray, variously spotted with several shades of rich deep brown.

The Partridge (*Perdix cinerea*) also is a favourite, and well known resident. The slight collection of dead leaves or dry grass which forms the nest is placed any where in a field, hedgerow, or margin of a thicket. The eggs, nine to twenty, are brown. I once knew a nest containing thirty-nine, but these were probably laid by two birds.

The Quail (*Coturnix vulgaris*) is an annual visitor, frequenting the neighbourhood of Birkenhead in some numbers. Owing to its retiring habits, it is seldom seen, and consequently much less known than either of the preceding. The abundant shelter in its favourite haunts in meadows and cornfields conceals it until the autumnal migration leads the majority to winter in more genial climes. Owing, probably, to the young being hatched, for the most part, before haytime, the nests are seldom found. The eggs are buff, variously spotted and blotched with rich brown.

The resident Ringed Plover (*Charadrius hiaticula*) breeds sparingly round the shores, but forms no nest. A shingly place at the junction of the land with the beach is a favourite situation for the purposes of incubation. The eggs, four in number, are placed *quatrefoil* in a slight depression, with the small ends towards the centre. They are large in proportion to the size of the bird, and unless arranged in the most economical manner with regard to space, the birds could not cover them. They are buff, spotted with black, and so closely resemble the surrounding ground that they are found with difficulty. All the wading and swimming birds are nocturnal as well as diurnal, and all are more or less wary. Their notes at night are often very different from those used by day.

The Lapwing (*Vanellus cristatus*) frequents the more retired and wilder portions of the district throughout the year. The poorest lands covered with a scanty vegetation are the most favoured in the breeding season; fallow fields also and spots where, through some local or other cause, the crop has failed, are used by a few pairs. It seems perfectly immaterial whether a nest is constructed or not; but as far as my own observations go, the birds always scratch a depression for the purpose. The eggs are quite as frequently laid upon the bare ground in this little hollow, as on a more or less well formed lining of dead grass. They are buff or brown, spotted with black; and being four in number, are placed *quatrefoil*; they are variable, and difficult to find. A considerable amount of damp does not seem to injure them, as I have often seen them in very wet nests without ever finding bad ones. There is a charm in the wild lands frequented by the Lapwing at this season which is not found elsewhere; the calm beauty of a mild, sunny, spring morning is enhanced by the quiet solitude, the wild but pleasant notes of the birds, their varied and graceful evolutions, and their stratagems to decoy an intruder from the neighbourhood of their nests or young. The latter run almost as soon as hatched, and have the instinct from the first to squat cunningly on gravel or amongst vegetation on the approach of danger. When thus concealed it is very difficult to detect them. The parents are ever near to warn, disperse, or call them together, by means of various notes and actions. At a late season they associate in flocks, resort to favourite feeding grounds on the land or shores, and continue thus till the return of spring.

I have good authority for stating that the Oyster-catcher (*Hæmatopus ostralegus*) has been known to breed near Hoylake. The eggs are pale brown, streaked and spotted with two or three shades of darker brown, and dull black.

The Heron (*Ardea cinerea*) may be seen in the district throughout the year, and most probably still continues to nest here, at least occasionally. There was formerly an established Heronry at Hooton, which, I am informed no longer exists; the eggs are green. Though it is extremely difficult to surprise so wary a bird, an observer may, by approaching under shelter of whatever is available, have opportunities of watching it feed. During the winter season more than two are seldom seen inland together, but there are favourite resorts on the shores where sometimes numbers congregate to feed. One of these places is near Flint, on the Welsh side of the Dee, where I have seen from thirty to forty in comparatively close proximity. There also may often be seen several rows, consisting of from two to ten individuals, arranged at moderate intervals, with single birds interspersed. The Herons thus forming a row will be at distances of a few yards apart, and in an almost straight line. The effect produced by their standing motionless in the margin of the water, waiting patiently for passing fish, is striking, especially should there be sandpipers, gulls, and other wild fowl all round. I am told that Herons congregate in a similar manner on the shore near Ellesmere Port. When these birds rise of their own accord without being disturbed, they sometimes describe a spire of gradually enlarging circles, until the desired elevation is attained. The slow, heavy, measured flight is then continued in an undeviating line for a great distance. Two birds rising with such a spire at the same time and place have a curious appearance, and give the idea of a double corkscrew. I have several times seen the leader of two flying Herons change its course on a call note being given by the second.

The common Sandpiper (*Totanus hypoleucos*) formerly visited the neighbourhood of Birkenhead in considerable numbers, but these have decreased until one or two pairs are all that now spend the summer there; the nest, generally near a pond or stream side, is occasionally some distance from water. The eggs are buff, dotted or spotted with reddish brown and leaden gray.

Three or four pairs of Woodcocks (*Scolopax rusticola*) frequented woods near Birkenhead last spring, and no doubt nested there. The eggs are rounder than those of other birds belonging to the tribe, and are buff, spotted with two or three shades of reddish brown. Others, as well as myself, have previously seen Woodcocks at intervals during the summer months, so that there is no doubt they at least occasionally breed here.

The Snipe (*Scolopax gallinago*) is resident, and may be met with singly or in pairs throughout the spring and summer. I have frequently seen them near Brimstage, where I am satisfied they nested. They may also be found in other localities at the same season. The eggs are light brown or greenish brown, spotted or blotched with several darker shades; curious varieties occur.

A few pairs of the Dunlin (*Tringa variabilis*) remain in the district throughout the spring and summer, and unquestionably breed here. The eggs are greenish gray or pale buff, variously marked with rich reddish brown. A person strolling on the shore in winter cannot fail to be struck with the quick, elegant action of a flock of Purres flitting past him in small parties over the margin of the water. A white cloud of countless numbers is seen at a distance seaward, but suddenly it vanishes; presently, a broad, brown centre connects a white end with a black one; then a white centre couples two dark extremities, and they all vanish for a time. Now a dark mass of objects is seen in rapid motion, again and again to disappear, and as often to reappear under some newly varying aspect, until at length all alight on the sandy banks. They are unsettled, or something disturbs them,—they rise again, perform more of these interesting evolutions, and finally disperse in small flocks. These varied appearances are produced according to the part of each bird seen at the time. The backs show brown, and the bellies white, and more or less of either would give corresponding shades; and when the flock has become invisible an extremity of each bird with the edges of the wings are turned towards the beholder. When pairing in spring the male Purres are very jealous and pugnacious, and are very amusing at that season.

The Landrail (*Crex pratensis*) annually visits the district in greater or less plenty to spend the summer. Its retiring habits cause it to remain concealed in favourite meadows or cornfields, consequently it is seldom seen. The note, however, is well known. The nest, composed of dead grass, is placed on the ground. The eggs, six to nine in number, are pale buff or whitish, spotted or blotched with reddish brown, and sometimes faded lilac.

The Water Rail (*Rallus aquaticus*) has been observed in the district throughout the year, so there is no doubt it breeds here. The eggs are pale buff, spotted with reddish brown and dull lilac.

The Moor-hen (*Gallinula chloropus*), a well known and abundant resident, is less shy than the preceding. Unlike many allied species, it frequently perches in trees and bushes, and where undisturbed, may be seen abroad at all hours. The Moor-hen frequents most sedgy ponds and waters, until frost compels it to seek food and shelter by the sides of streams. Although not webfooted, it takes the water freely and swims well. The nest, composed of various aquatic plants lined with the soft, dry portions, is a high, rude, rather bulky structure. It is placed on the water amongst the branches of a bush or rank vegetation in the shallower places, and is fastened firmly to whatever is near it. I have seen one on a spreading branch immediately overhanging the water of a mill-pool. The eggs, six to eight in number, are buff, spotted with various shades of reddish brown. I have heard of thirteen young ones following one old bird, and have myself seen ten eggs in the same nest. A curious circumstance with regard to these latter was, that six were considerably incubated, whilst four were only slightly so. The question naturally arises, were all laid by one bird ? If they were, it is a singular instance of irregularity. Domestic fowl, I believe, occasionally lay one egg or more at intervals whilst sitting, but that a wild Moor-hen should lay four in succession seems strange. If the four were laid by a second bird, great watchfulness on her part, and perhaps regularity on the part of both, the one in leaving the nest and the other in laying, are indicated. The second bird may have been the stronger, and may have pushed the other off the nest when she wanted possession; or perhaps a friendship existed between them. The young leave the nest soon after exclusion from the eggs, and I have seen one of the first-born scrambling up the side before the late ones were hatched.

The Coot (*Fulica atra*) sometimes visits the district, and may occasionally nest on retired pools within the ten miles' circuit. The bird is resident and breeds regularly in different localities within easy distance. The eggs are buff, dotted and spotted with dull black.

The Shelldrake (*Tadorna vulpanser*) occasionally nests at Hilbre. The nest is placed in a rabbit burrow, often far down, but in other respects, I believe, is similar to that of ducks. The eggs are white, tinged with a shade of greenish buff.

The Wild Duck (*Anas boschas*) is probably resident in most years. It sometimes nests at Brimstage and the adjoining part of Storeton. The nest is generally on land, and not necessarily near water. It is composed of grasses, &c., carelessly arranged, and during incubation feathers and down are accumulated to a great extent about it. The eggs are greenish buff.

The Teal (*Anas crecca*) occasionally breeds here. In the spring of 1856 I received eighteen eggs from the neighbourhood of Leasowe. They were taken from three different nests, but were most probably laid by one bird. The first nest was composed of a great quantity of material, well lined with feathers and down, whilst the second and third were of less material, and no feathers. All were amongst grass, near reedy ditches between Leasowe and Wallasey. The first contained the complement of nine eggs, the other two, five and four respectively; all were of a pale cream-colour.

My authority for the Oyster-catcher also told me that either the common Tern (*Sterna hirundo*) or the lesser Tern (*Sterna minuta*) had been known to breed at Hoylake. He was not certain which it was, but either one or both may occasionally nest there, or in the neigbourhood of Crosby. I have seen the common Tern apparently located beyond Crosby, and the lesser Tern is sometimes common between the Point of Air and Rhyl. The eggs of the former are very variable. They are pale brown, spotted and blotched with dull dark gray, and several shades of deep brown. Those of the latter are light brown, spotted with dull dark gray, and various shades of deep brown.

I have now noticed all the birds which I have ascertained to nest here, except the Garden Warbler, which will be mentioned in the supplement to the first part of this paper. I have also referred to several which there is good reason to believe do so. The total number, ninety-six, is probably a fair amount for so small an area in the British Isles. Should the doubtful ones, not more than eight, be discarded from consideration, the list, I think, would still be a good one. A few localities are richer in wild fowl, but I doubt whether any similar area in Britain produces a total of more than about one hundred nesting species. I have not seen any similar lists, so that I have not been able to make a comparison. Continued research may detect not only the doubtful birds already mentioned, but a few other occasional, if not permanent nesters. It would not be difficult to point out a few likely birds.

Differences of seasons materially affect birds at the nesting time. Late springs, with settled fine weather afterwards, are good; whilst early ones, with late frosts, are bad. Very wet springs are equally injurious to land birds, and the last season being one of this description, was marked with detrimental results. Many early nests of eggs on the ground were wholly or partially destroyed, whilst many of those in bushes suffered. I saw several wrens' nests in bushes become mouldy before they were finished.

SUPPLEMENT TO THE FIRST PART.

I have ascertained that the pair of Kestrels mentioned as frequenting a large rookery, did not occupy a rook's nest, but that they had their own on the top of an artificial ruin in the midst of the rookery.

The Sparrow-hawk sometimes lays all her eggs on consecutive days, and at others, two or three in that manner, and the rest at longer intervals. Incubation lasts a calendar month, and the young ones remain in the nest for about another month, so that probably three calendar months expire from the commencement of nidification to the time the offspring are finally left to shift for themselves. The young are born blind, but open their eyes to the full extent within a week. Being covered with a white down, they are pretty objects from the first. A nest containing five which I was watching last spring gave me some opportunities for observation. Unfortunately, the young ones perished prematurely on the ground underneath, apparently through being frightened by boys who found them. On visiting the nest on probably the second day after the young had scrambled out, I found a store of twenty-three small birds besides portions of several others. Some were decapitated, others partially so, and all were plucked; the majority were perfectly fresh. They comprised thirteen sparrows, one greenfinch, one yellow bunting, one black-headed bunting, one cole, or marsh-tit, four young robins, and two which I could not identify. These, probably less than a two days' store, will give an idea of the havoc committed amongst small birds by the Sparrow-hawk. Even allowing an average of two per day to each, the number devoured by one individual would be seven hundred and thirty in a year. The male bird takes part in incubation.

On examining a considerable number of castings of the Barn Owl during last summer I discovered the skull of a sparrow, and one of some kind of thrush. This species, therefore, evidently preys occasionally on small birds, though far less frequently than the long-eared owl.

The Red-backed Shrike has again visited the district during the present year, and reared young at Rainhill.

During last spring, I found a second instance of a thrush's nest in the cavity of an old magpie's. Whilst in Wales last May I saw so many on the ground, in woods, that they almost ceased to be remarkable in that situation.

From accounts received from boys, a pair of Ring Ouzels visited the neighbourhood of New Brighton this year, and frequented the ground called the Warren through most of the spring. Nests of the Whinchat, built on the ground like those of larks, are not uncommon. I saw several such last spring, but none were at any great distance from a bush.

A pair of Garden Warblers (*Curruca hortensis*) visited the neighbourhood of Prenton Mount last Spring, but through going from home at the time I did not see the nest. During last May I saw some nests of the Blackcap Warbler which were built amongst thick nettles. They were so like the ordinary nest of the whitethroat, that prior to their containing eggs, I was inclined to attribute them to that species. Judging from the nests alone, therefore, it is often impossible to decide to which bird they belong. I also found a standard nest of the Blackcap suspended in a bush of honey-suckle. Several sprays of the bush were woven into the rim, which was rendered firmer than ordinary by the interweaving of bits of wool with the rest of the material. There was no other support whatever. A second similar nest was suspended from the spreading branch of a tree, at an elevation of seven or eight feet.

The Wood Warbler's nest is domed. The dome is so slightly constructed, and so very slightly attached to the lower part, especially near the entrance, that it is very easily displaced. The nest, therefore, after being many times visited by the birds, or otherwise disturbed, is apt to have the appearance of being only half domed, as previously described. Six or eight nests found last spring, and examined minutely, bear out this view. All were constructed of coarse grass, lined with the softer portions, and a few straggling hairs. One example, similar to the rest in other respects, was partially lined at the bottom with five or six feathers. All were in depressions scratched in the ground by the birds; all were likewise on slopes in woods, and nearly, if not quite buried by fallen leaves and dead bracken. The nest cannot be seen, and the best way to find it is to flush the old one off, or watch her down to it. On several occasions visiting one containing young, the old bird hobbled down the bank for several yards, as if lame. It appears to be the habit of the species to do this, as I saw other individuals do the same. The complement of eggs is five or six.

The nest of the Chiff-chaff is also domed. The remarks just made about the dome of the Wood-wren's nest apply equally to this. In other respects, the nest is as formerly described; but in addition to being on or near the ground, it is not unfrequently placed in thick furze, prickly box, or other similar bush, at an elevation of sometimes as much as a yard. The site is variously chosen in a wood, and not necessarily near the margin. The complement of eggs is five or six. The Chiff-chaff will sometimes remain so closely on her nest that a person may almost walk over it without causing her to fly off.

Last winter was apparently a disastrous one for the Golden-crested Wren. During the subsequent spring there were very few in the Cheshire firwoods, where they generally abound throughout the year.

The Marsh Tit is certainly resident, and breeds here. I found a nest last spring containing callow young. It was built in a wall which bounded a wood.

Two nests of the common Bunting which came under my notice last season, were built in depressions scratched by the birds in the ground, amongst thick star-grass on the Sandhills. Both were constructed of grass, principally stalks, lined with fine fibres and a few hairs. Two others, found by a friend, were described to me as similar to these in every respect.

I also saw three nests of the Yellow bunting built in hollows scratched in the ground by the birds. These situations were evidently from choice, and not necessity, as there were plenty of young trees and bushes all round.

Two or three nests of the Chaffinch, seen during the past season, were profusely lined with a mixture of feathers and the standard hair.

Nests of the Lesser Redpole occur at various elevations in trees, as well as in the situations previously mentioned.

At the conclusion of the paper, the PRESIDENT remarked that he had listened to it with great attention, and complimented Mr. Brockholes upon the interest which he had thrown around the subject. He made some observations upon several of the topics which had been touched upon, corroborating the writer, and further illustrating the subject.

Dr. COLLINGWOOD bore testimony to the usefulness of the paper, which was full of original information, not derived from books, but the result of long, and patient, and watchful communion with Nature. In reply to a question raised by Mr. Higginson as to whether it was true that the Swallows had left this country a month earlier than usual on account of the inclement weather, he remarked that he scarcely believed it probable, or borne out by experience, that they should antedate their departure by so long a period. Birds seldom were influenced by the weather to so great an extent in their migrations; and the fact of the Swifts having remained their full time would seem to militate against it.

After some further discussion, the subject dropped.

EXTRAORDINARY MEETING.

After the business of the Ordinary Meeting, an Extraordinary Meeting was held, for the purpose of confirming the proceedings of the last meeting in reference to the election of Mr. William Brown as a corresponding member of the Society. The resolutions of the last meeting having been read, a ballot was again taken, and Mr. William Brown was declared duly elected a Corresponding Member.*

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* Mr. William Brown having been elected an Honorary or Corresponding Member by each of the five learned societies of the town, the occasion of the opening of the New Free Public Library and Museum, October 18th, 1860, was considered a fitting time to present him with a joint Address, which was accordingly done at the Town Hall on the morning of the ceremony, in the presence of the Mayor (T. D. Anderson, Esq.), the Joint Councils, and numerous corporate, and other officials.

The address was read by Mr. J. Abraham, Hon. Sec. to the Joint Councils, and was handed to Mr. Brown by the Rev. H. H. Higgins, President of the Literary and Philosophical Society, who accompanied the presentation with suitable remarks. It was as follows:—

"TO WILLIAM BROWN, ESQ., OF RICHMOND HILL, LIVERPOOL.

SIR,

When you intimated your intention to present to the public a building for the Free Public Library and Museum of this town, and subsequently, when the foundation stone was about to be laid, several of the local learned Societies expressed to you their gratitude and good wishes.

You have since become entitled to their more especial acknowledgements. Within the present year you have given another proof of the warm interest which you feel in the progress of science, by providing an additional and spacious hall for the purpose of exhibiting objects of interest illustrative of the useful arts, and you have honoured our five Societies by requesting their advice and co-operation in its management.

To render this they consider their duty and their privilege: and as a means of expressing their entire and hearty appreciation of your munificence and courtesy, each of those Societies has had the pleasure of enrolling you in that class of its members which by its laws and constitution is most honourable, and they have jointly entrusted to us the agreeable duty of making to you this public and official intimation of the fact."

This Address, beautifully engrossed and illuminated upon vellum, was signed by the Presidents and Secretaries of the five Societies, in Alphabetical order, as follows:—

The Architectural and Archæological Society.
The Chemists' Association.
The Historic Society of Lancashire and Cheshire.
The Literary aud Philosophical Society.
The Polytechnic Society.

SECOND ORDINARY MEETING.

Royal Institution, October 29th, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The following Gentlemen were ballotted for, and elected Members of the Society:—

Rev. W. Banister, B.A.,
David Walker, M.D., F.R.G.S.,
(late Surgeon to the "Fox," Arctic exploring vessel,)
and Mr. Frederick Kirby.

The **President** announced that he intended arranging a series of working botanical excursions, in connexion with the Naturalists' Field Club, on Saturday afternoons, when the weather was favourable. A beginning was made on the previous Saturday, when a dozen ladies and gentlemen had accompanied him to Rock Ferry.

Dr. **Collingwood**, being called upon for the additions made to the local Fauna during the past year, said, that although much had been learnt, the results obtained were rather of a negative than of a positive character. He had been requested by the British Association, at its last meeting at Oxford, to dredge in the rivers Mersey and Dee, for the purpose of perfecting, as far as possible, our knowledge of those rivers; and with that view he had made three or four excursions during the summer on both rivers. He had not, however, to announce a large addition to the number of specific forms found in them, but had accumulated much information with regard to the distribution and numbers of certain species. Among other results, he had satisfied himself that the common *Doris aspera* has not yet been found on these shores, while on the other hand, its allied species, *D. proxima,* though no hitherto found elsewhere, is here everywhere common. It was this group of naked-gilled Mollusca which had perhaps been most studied; and two species had been added to the list namely, *Eolis exigua,* which he had found at Egremont, and *E. olivacea,* brought by Dr. Edwards from Hilbre Island on the occasion of the Field Naturalists' excursion there; on which occasion, also, a new compound Ascidian, *Clavellina lepadiformis,* had rewarded the search. *Pilumnus hirtellus* a species of crab, he had found upon the Egremont shore; and it had since been met with by Mr. Moore at Hilbre. Among the fresh-water Polyzoa some discoveries had also been made, viz., *Lophopus crystallinus,* found by Dr. Edwards in a ditch at Oxton; and *Plumatella repens,* brought by Mr. Moore from Raby. The small number of absolute additions made to the Fauna from year to year he regarded as a strong proof of the excellence and accuracy of the Fauna list prepared by Mr. Byerley, and published by the Society in 1854.

Dr. WALKER exhibited the egg of the little Auk (Alca alle) taken by himself in latitude 76½° N. Also a specimen of Anorthite, a mineral new to the British isles, and consisting of silica, alumina and lime, with traces of magnesia and oxide of iron. It was from Ireland.

Mr. DUCKWORTH exhibited a bow and arrows of the Veddahs of Ceylon.

Dr. COLLINGWOOD read a letter he had received from Professor Krauss, Director of the Zoological Department of the Royal Museum at Stuttgart, requesting him, if possible, to cause some marine Invertebrata from the British seas to be sent to the latter in exchange for other objects. Dr. Collingwood referred the subject to the keepers of the Free Public and

Royal Institution Museums, and pointed out a means by which they might possibly be preserved sufficiently for scientific purposes.

A paper was then read, of which the following is an abstract:—

ON DARWIN'S THEORY OF THE "ORIGIN OF SPECIES."

BY THE REV. H. H. HIGGINS, M.A., PRESIDENT.

Mr. HIGGINS, in his introductory remarks, stated that it had been his intention to submit to the society an original paper on Mr. Darwin's book; but on reflecting that such a course would lead only to the addition of another review to the numbers which had already appeared, treating the subject more fully and more ably than he himself could hope to do, he had resolved to found his observations on the criticisms contained in the various serials in which Mr. Darwin's work had been reviewed. Some of the best of these he had not yet had time to examine; his remarks would, therefore, necessarily be very incomplete.

He considered the paper by M. Agassiz, inserted in the *Annals and Magazine of Natural History*, to be quite unworthy of so distinguished a naturalist. Having entered at some length into his reasons for holding this opinion, he said:— A singular argument is used by M. Agassiz to show that affinities between animals are not evidences of genealogical relationship. Similarity, he argues, between adult animals, is but an agreement in a single stage, and, if agreement in a single stage be sufficient to prove genealogical relationship, then, since the embryos of very distinct animals are much alike, there must be close relationship between these very distinct animals; a *reductio ad absurdum.* M. Agassiz thus writes:—"A young snake resembles a young turtle or a young bird more than any two species of snakes resemble one another, and yet they go on reproducing their kinds, and nothing but their kinds; so that no degree of affinity, however close, can in the present state of our science, be urged as exhibiting any evidence of community of descent." A child might reply, if a young snake is more like a young bird than one old snake is like another, a young snake is not so like a young bird as it is to another young snake; so affinity, after all, is right in its indications. But this would be to concede to M. Agassiz far too much. Does an embryo snake resemble an embryo bird more than two kinds of snakes resemble each other? Differences of embryos must surely be compared amongst themselves, and not with the distinctions subsisting between adults.

M. Agassiz suggests:—"Would the supporters of the fanciful theories, lately propounded, only extend their studies a little beyond the range of domesticated animals; would they investigate the alternate generation of the Acalephs, the extraordinary modes of development of the Helminth, the reproduction of the Salpæ, &c., they would soon learn that there are in the world far more astonishing phenomena, strictly circumscribed between the limits of unvarying species, than the slight differences produced by the intervention of man amongst domesticated animals, and perhaps cease to be so confident as they seem to be, that these differences are trustworthy indications of the variability of species." It is, no doubt, desirable that Mr. Darwin and his supporters should not remain in ignorance of the "astonishing phenomena" connected with the transformations of the Salpæ, Medusæ, &c., though it is not clear why these changes should be more astonishing, *except to those to whom they may be novelties,* than the transformations undergone by insects; but, in the matter of the argument, the illustration given by M. Agassiz is altogether wide of the mark, for the simple reason that the transformations of the Medusæ are not varieties at all, any more than the caterpillar is a variety of the butterfly. *

Mr. Higgins then quoted some passages from a paper in the *National Review,* in defence of Mr. Darwin's theory. He also gave an outline of an article by Mr. W. Hopkins in *Fraser's Magazine*, for June and July, 1860, which he thought to be, on the whole, the best and most philosophical review of the subject he had seen. The following is an extract from it:—"At what period of his progressive improvement did man acquire the spiritual part of his being, endowed with the awful attribute of immortality? Was it an accidental variety seized upon by the power of natural selection and made permanent? Is the step from the finite to the infinite to be regarded as one of the indefinitely small steps in man's continuous progress of development, and effected by the operation of ordinary natural causes? We can scarcely suggest these questions without an apprehension of their being deemed irreverent. But they force themselves irresistibly upon us in considering these theories in regard to their legitimate and almost necessary extension to man. The difficulty of passing, according to any theory of development, from the finite to the infinite, from the mortal to the immortal, cannot be avoided by any advocate of such theories, except by denying the immortality of man or admitting that of a sponge or a polyp."

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* Since writing the above, I have had the advantage of hearing Dr. Collingwood read an able and interesting paper in defence of M. Agassiz' criticism. On further consideration, my first impressions are, however, confirmed. The greater the eminence of the writer, the more deeply it is to be regretted that he should adopt the tone of M. Agassiz, who thus characterizes Mr. Darwin's work:—"Instead of facts, we are treated with marvellous bear, cuckoo, and other stories. Credat Judæus Apella!" No mere vulgar raillery could be half so offensive as the following:—"I apprehend that the meaning of the words he (Mr. Darwin) uses has misled him into the belief that he had found the clue to phenomena, which he does not even seem correctly to understand." The charge of materialism against Mr. Darwin's work I have elsewhere attempted to meet. Such an assertion as "the powers to which Darwin refers the origin of species can design nothing," was not to be expected from M. Agassiz. Whatever, on any physiological hypothesis, may be the differences or resemblances subsisting between embryos, to say that adults differ more than embryos, and to attempt to found on this observation a scientific proposition, appears to me to be as unphilosophical as anything that can well be conceived. The transformation of Acalephs are not, it is true, strictly analogous with those of insects, because the transformations of the former animals are complicated with the process of reproduction by division, peculiar to lowest forms of life. In both insects and Acalephs, however, the transformations are strictly confined to a limited cycle, and such transformations have, therefore, not even the remotest analogy with the "variations" of which Mr. Darwin writes. I do not pass on to notice other points, because it was not my object in writing to censure M. Agassiz' criticism, but only to express an opinion on his and other reviews of Mr. Darwin's theory.

H. H. H.

Mr. Higgins, after noticing several other articles, referred to one appearing in the *Annals and Magazine of Natural History*, for February, 1860, and continued as follows :

The reviewer asserts "it is quite evident that there is an idea involved by naturalists in the term species, which is altogether distinct from the fact of mere outward resemblance, namely, the notion of blood-relationship, acquired by all the animals composing the species through a direct line of descent from a common ancestor." Therefore, the reviewer argues "it is no sign of metaphysical clearness, when Mr. Darwin refuses to admit any kind of difference between genera, species, and varieties, except one of degree." I do not think the idea of blood-relationship is necessarily involved in the term species, unless we go so far as to assume that all species have respectively sprung from a single pair. Most naturalists would probably agree with M. Agassiz, that, on the first appearance of a species, many pairs were created, though an exception may be made in the case of man. Now, between the many pairs of the same species simultaneously created, we do not see how blood-relationship can be assigned; the location of their descendants in a species has been founded on their nearly perfect resemblance to each other; other groups, having less perfect resemblance, together with them, form a genus; the distinction is, therefore, one of degree only. The reviewer continues,—"To our mind, indeed, the whole theory of natural selection is far too utilitarian;" and he instances the difficulty of conceiving the exquisite varieties of pattern on the wings of many insects to be the result of natural selection founded on advantageous differentiation. This is a view of the subject in which I heartily concur. Many insects are very variable in their colouring; the common currant-bush moth for example; yet, from the number of intermediate specimens, there is reason to believe the extreme varieties breed freely together. Distinctions between other species are founded on the most minute differences in the pattern; amongst these no intermediate forms are found, and there is reason to believe that, though hardly distinguishable from each other, the individuals of such closely allied species, differing only in a speck of colour, never breed together. Now, according to Mr. Darwin's theory, these closely allied species diverged from a common point, in starting from which their differences were even less than at present, and so a fraction of a speck of colour is supposed to have given them the victory in the battle of life, to have prevailed to the extinction of intermediate forms, and to have set them so far asunder that they never breed together. I can, therefore, fully enter into the difficulty urged by the reviewer, founded on the altogether utilitarian basis of the theory of natural selection. But I cannot agree with him when he points to the exquisite beauty of the wings of insects, and asserts that no such surpassing loveliness could have arisen from natural causes. What are natural causes, after all, but the instruments used by the Omnipotent mind—the very chisel and the paint-brush of the infinite artist? A flower is, in every particle, the expression of a thought entertained in the creative mind before the plant was brought into existence. Is it less so because, instead of calling the herb into life and beauty instantaneously, the Creator sets in motion agencies which produce the result only after the lapse of thousands of ages? I do not say this has been His method, but only that I see in it nothing unworthy of Him. When, therefore, the reviewer speaks of Nature as a "pestilent abstraction," he seems to me to use intemperate language: Nature is but the expression of a portion of the Creator's mind. We need some word to indicate that wondrous train of causes and effects between which we, by investigation, are able to discover some connexion. Nevertheless, it has been the fate of every attempt to advance this kind of investigation to meet with the charge of impiety. It may be worth while to examine the condition of mind implied in an author who speaks of Nature as a pestilent abstraction. How Nature can be an abstraction at all it is hard to see. Man may succeed in representing the Creator as an abstraction; and it is quite possible that, identifying Him with qualities repugnant to all that we know of Him, the false notions of some respecting Him may be little else than a pestilent abstraction; but how in Nature, made and upheld by Him who is wisdom and power, and who names himself by a still more touching attribute; how in all Nature, from the universe to an atom, there can be anything deserving to be called a pestilent abstraction, may be plain to the reviewer, but we may, perhaps, hesitate in considering such perspicacity a valuable qualification for a writer on Natural History. The review before us is not, however, characterized by anything like general unfairness. There is a want of strict logical accuracy in many passages; but others are written in good feeling and apparent candour, as an instance of which I may, in conclusion, quote the reviewer's estimate of the value of Mr. Darwin's theory. "There is a reasonableness about it which commands our respect. It enables us to account for many a trifling variation which, because permanent, naturalists have usually regarded as of necessity aboriginally distinct, and smooths down some of the minor controversies concerning the value of minute modifications, which may properly be referred to direct agencies from without. Indeed, we will go a step further and affirm there is no reason why varieties, strictly so called, though too often, we fear, mistaken for species, and also geographical sub-species, may not be gradually brought about by this process of natural selection; but this unfortunately expresses the limits between which we can imagine the law to operate, and which any evidence, fairly deduced from facts, would seem to justify. It is Mr. Darwin's fault that he presses his theory too far."

Mr. Higgins expressed his intention of resuming the subject at a future meeting of the society.

Dr. COLLINGWOOD said that he could scarcely coincide with Mr. Higgins' estimate of Agassiz' criticism, which to him, appeared the most damaging and the most conclusive one which had yet appeared. Twelve months ago, when Agassiz' "Essay on Classification" was under discussion in that room, he (Dr. Collingwood) had expressed his opinion that it would be highly useful in counteracting the impression likely to be produced by the forthcoming work of Mr. Darwin, whose views he had heard expounded at their first announcement before the Linnæan Society. Having since read the book, and the reviews upon it, and heard discussions among able men upon its merits, he had formed an opinion, and not a hasty one, for during the past twelve months it had undergone more than one phase of doubt. That opinion was not favourable to its stability or general application. The arguments of Darwin were specious, and urged with so much earnestness and evidence of his own belief in their validity, that they were liable to carry away the reader at first, until consideration and cooler judgment came to his assistance. He (Dr. Collingwood) had intended to have entered upon the subject this evening, but, having been unprepared for so unfavourable a criticism upon the remarks of Agassiz as they had just heard, he did not feel willing to enter upon his defence at once, but wished more carefully to read his statements, and more deliberately to weigh them, and to have the advantage of placing his own thoughts in writing. He regarded, however, the works of Agassiz and Darwin as entirely antagonistic; and considered that the idea of a *species*, as given by the former, who considered it a life-history, embracing all the individuals composing it, their habits and economy, was a noble one, contrasting most favourably with the Darwinian hypothesis of *transmutation*, for such it was, although his supporters disliked the name.

The **President** said he hoped Dr. Collingwood would favour the society with a defence of Agassiz' remarks,—which the latter promised to do.

Mr. **Morton** remarked that the lines formerly regarded as separating geological systems were gradually becoming more and more indistinct, as the result of increasing knowledge. In the British strata, the close of the Cretaceous system marks the most important break. The Permian rocks seem to pass insensibly upward into the Trias, though the absence of organic remains excludes any definite conclusion. With regard to all the other systems, there is certainly a gradual change in the prevailing species, so that although in some cases species appear to have been suddenly introduced, the general inference is, that the introduction of new species was very gradual. Hence, the difficulty geologists now find in deciding the limits of systems.

In reply to a remark that few scientific men of eminence had given a distinct opinion of Darwin's work, Dr. **Collingwood** read an extract from the address of Sir Charles Lyell to the Geological Section of the British Association at Aberdeen, in which he spoke of Darwin's theory as throwing a flood of light upon many groups of phenomena which had not hitherto been attempted to be explained. He also exhibited specimens of Lingula from the Lower Silurian rocks, and recent Lingulæ from the modern seas, remarking that that Mollusk was a living testimony against Darwin's theory, inasmuch as it could hardly be conceived that, if natural selection had been at work for the countless ages which had passed between the lowest fossiliferous periods and the present, the Lingula should have profited so little by it as not merely to be *not* developed into some higher form, but to remain a Lingula in no respect superior to its Silurian ancestors.

Mr. **Duckworth** observed that starfishes were found in the Upper Silurian that exhibited no perceptible marks of difference from those existing in the present day.

The Rev. J. **Robberds** deprecated the *odium theologicum* being cast upon the subject. He was glad to hear the President concurred with him, for he conceived that either theory was equally compatible with the reverence due to the Almighty.

THIRD ORDINARY MEETING,

ROYAL INSTITUTION, 12th November, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Messrs. PHILIP H. RATHBONE and CHARLES SPENCE were elected members.

The PRESIDENT announced the decease of Mr. Richard Rathbone, one of the original members of the Society. Three, only, of these now remain, viz., Messrs. William Rathbone, J. Houlbrooke Smith, and Dr. Traill, of Edinburgh—the last a Corresponding Member.

Dr. IHNE proposed a new mode of Shaksperian reference. Several plans had been adopted which were more or less open to objection; thus, the number of the scene was sometimes given, but scenes were occasionally very long, even as much as five or six pages. It was not practicable to use the same mode of concordance as was adopted for classic authors, namely, the number of the line, because, in dialogues, a line was not unfrequently occupied by two interlocutors, and was consequently printed sometimes as one, sometimes as two lines; besides which, prose was often interspersed with verse. Dr. Ihne thought, however, that if the *number of speeches* in each scene were counted, and a reference given accordingly, the difficulties which met the student of Shakspere in the ordinary concordance would be obviated.

Mr. MOORE exhibited a living specimen of the Menobranchus (*Necturus maculosus*), a very remarkable animal from North America, whence it was brought by Mr. P. P.

Carpenter of Warrington, and placed in the Free Public Museum. It belongs to the very anomalous order of *Perennibranchiate Amphibia,* in which the gills remain external throughout life. There are but four known genera of this very curious group, the remaining three being, the *Axolotl,* the *Proteus,* and the *Siren,* examples of each of which genera were exhibited by Mr. Moore, preserved in spirits.

A paper was then read, of which the following is an abstract: *

ON "CAPTAIN SPRYE'S SCHEME OF COMMUNICATION WITH WESTERN CHINA, THROUGH PEGU AND BURMAH."

By H. DUCKWORTH, F.R.G.S., F.G.S.

The object of this communication was to give a summary of a project recently placed before the Government and commercial community of this country by Captain Richard Sprye, formerly an officer in the H. E. I. C. service.

In his prefatory remarks the author observed that our most recent acquisition of territory in Burmah, or rather in Pegu, had brought us within some 250 miles of the Chinese frontier.

There being no direct communication between the two countries, it became a most important question whether it would be possible and profitable to establish one.

The seven most western and inland provinces of China proper are situated between about 22° and 42° north latitude, and lie far west of the extreme point to which Lord Elgin proceeded up the Yang-tse-kiang.

The chief natural productions of YUN-NAN (area, 107,969 square miles; population, 8 millions) are rice, silk, musk, various kinds of drugs and tea. Gold, copper, lead, cinnabar, and orpiment are abundant; indeed, Yun-nan excels all the other provinces in its mineral wealth.

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* This paper has been separately published by the Author.
London: G. Philip and Son, 32, Fleet street. 1861.

KWANGSEE (area, 78,250 square miles; population, 10½ millions) produces abundance of rice, cassia, and valuable furniture-woods. Gold, silver, and quicksilver are the principal minerals.

KWEICHOO (area, 64,554 square miles; population, 7½ millions), yields wheat, rice, musk, tobacco, cassia, and precious timber; and lead, copper, mercury, and iron are found in its mountains.

HOONAN (area, 73,000 square miles; population, 33 millions) is one of the richest provinces in the empire, and produces immense quantities of grain, principally rice. Its teas are said to be remarkably fine. Iron, lead, and coals are abundant; and the mountains produce fine cassia, and various other kinds of timber.

SZE-CHUEN (area, 166,800 square miles; population, 30½ millions) is the largest, and, according to Abbé Huc, the finest province in China. Its fertility is such that it is said the produce of a single harvest could not be consumed in it in ten years. Its principal productions besides grain, are indigo and various tinctorial plants, fine teas, silk, sugar, grasscloth fibre (Boehmeria nivea), and many kinds of valuable drugs.

The climate of SHENSEE (population 14½ millions) is too cold for rice and silk, and their place is supplied by wheat and millet. Rhubarb, musk, wax, red lead, coal, and nephrite, are the principal articles of exportation.

KANSU (population, 22 millions; area, with the last, 154,000 square miles) produces wheat, barley, millet, and tobacco of very superior quality. A large traffic is carried on between this province and Tartary in hides and coarse woollen cloths.

The means of reaching these seven rich and densely populated provinces from the Bay of Bengal is very simple. Taking Rangoon as the starting point, it is proposed to connect that port with an emporium in the north-east corner of Pegue, *i.e.*, under the magnificent Karen Hills, at the most extreme north-eastern limit to which we can lay claim. From this emporium, which would be almost equi-distant from Rangoon and the Chinese frontier, the line of communication would pass through Burmah-Shan territory to Esmok (or Szemaou), a border town of Yun-nan, and a point at which several caravan roads converge directly from various parts of the province, and indirectly from the whole of the western half of the empire.

In order to take in chief towns and our military stations, the line would proceed thus:—1st stage, Rangoon to the ancient city of Pegue—the intervening country being almost level. 2nd stage, from Pegue over flat land, across the Sittang River to Shoe-Gyen. 3rd, Shoe-Gyen up the left bank of the Sittang and Kyoukkee rivers to Baukatah, a distance of 35 miles (lat. 18° 08′ 13″, lon. 96° 48′ 45″). 4th, from Baukatah up the left bank of that river, and its tributary, the Peemabhu, to Thayet-peen-keentat (lat. 18° 21′ 13″, lon. 97° 02′ 00″), also 35 miles. 5th, Across the water-shed between the Sittang and Youngsalen to the Kwestookee branch of the Thaiboot river, and down their right or left banks to the Youngsalen, down and across which, to Tseekameedac (lat 18° 25′ 58″, lon. 97° 19′ 00″). 6th, thence over the water-shed between the Youngsalen and the Salween to our frontier line under the Karen Hill country, where we are within reach of all the Chinese and Shan caravans which traverse the countries north-east and west of that point.

Another most important and prominent feature in the project is the establishment of an electro-telegraphic communication along the whole route. The line, once brought to Esmok, could be easily carried across country to the Pearl River, and down the lower valley of that stream to Canton and Hong Kong; and, thence, taking the principal towns along the coast (Amoy, Foochow, Ningpo, and Shanghae) to Pekin.

In like manner, by extending the communication to Niewchiang, and down the Corea, the open ports of Japan (Nangasaki, Kanagawa, and Hakodadi) might be brought to the very door of Rangoon, which already possesses telegraphic connection with Calcutta.

FOURTH ORDINARY MEETING,

ROYAL INSTITUTION, 26th November, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

JAS. KENWORTHY, M.D., and Mr. W. H. TOOKE, were elected members.

Mr. MOORE, of the Free Public Museum, exhibited some very remarkable living specimens of leathery turtles (*Trionyx ferox*), brought from Savannah by Captain Mortimer, of the ship "Florida," and deposited by him in the Museum.

The PRESIDENT remarked that excellent opportunities were frequently afforded to the numerous captains trading from this port of bringing specimens for the enrichment of the Museum. He wished, as there were in the room several influential gentlemen connected with shipping, that they would make it known to their captains that the committee of the museum would always be willing to defray the expenses of bringing such specimens, and would be very glad to encourage their being brought.

It was suggested that captains required some instructions to know what to bring, as they were liable to be laughed at, and receive no thanks, if they brought well known and common specimens.

Mr. MOORE said that he had prepared a manual of such instructions, which was ready for the press; meanwhile, he would be glad to give every information in his power to sailing-masters, and would promise them that whatever they brought they should not be laughed at for their trouble.

Mr. FABERT exhibited some very rare and perfect specimens of red coral (*Distichopora coccinea*) from the lately discovered Gambier island. The coral itself was first described by Dr. Gray, about two years since. The polyps forming this coral, as was remarked by the President, are of a lower organization than those forming white coral; and differ from them in structure, and in invariably possessing eight tentacula. Mr. Fabert also exhibited several interesting shells of the genus Cypræa; a remarkable land shell (*Helix Busbeii*), found on the tops of trees in New Zealand; very interesting specimens of Janthina, with their floats of eggs; and a singularly fine specimen of the parasitic Fungus, Sphæria entomorhiza, growing from the head of a caterpillar, and in excellent fructification.

The following paper was then read:—

ON SOME RESULTS OF THE *ROYAL CHARTER* STORM.

By THOMAS DOBSON, B.A.,

(Head Master of the School-frigate "Conway.")

In examining the results of the bad weather in the months of October and November, 1859, I shall notice very briefly the effects on shipping of the excessive motion of the air; and direct my attention chiefly to some of the less known consequences of the extreme changes in the air's pressure and temperature during the great atmospheric paroxysm of which the "Royal Charter" storm was only a portion.

I have constructed the curves of the pressure, and of the maximum and minimum temperature, of the air, from continuous observations made every six hours, during the months of October and part of November, at Kew, at Wakefield Prison, at Stonyhurst College, Lancashire, and at the Bishop's Rock Lighthouse, Scilly Islands. The character of these curves is so nearly identical that I have selected the Wakefield curves as exhibiting a fair type of the state of the atmosphere as to pressure and temperature over the whole of England at that time.

The dark line in the diagram * represents the vertical fluctuations of the barometric column of their actual dimensions: the upper boundary of the shaded zone denotes the maximum temperature, and the lower boundary the minimum temperature, as determined by self-registering thermometers. An inch of vertical space is here equivalent to 20° Fahr., and one-tenth of an inch of horizontal space to twenty-four hours.

The Admiralty Register of Shipwrecks on the coasts of the

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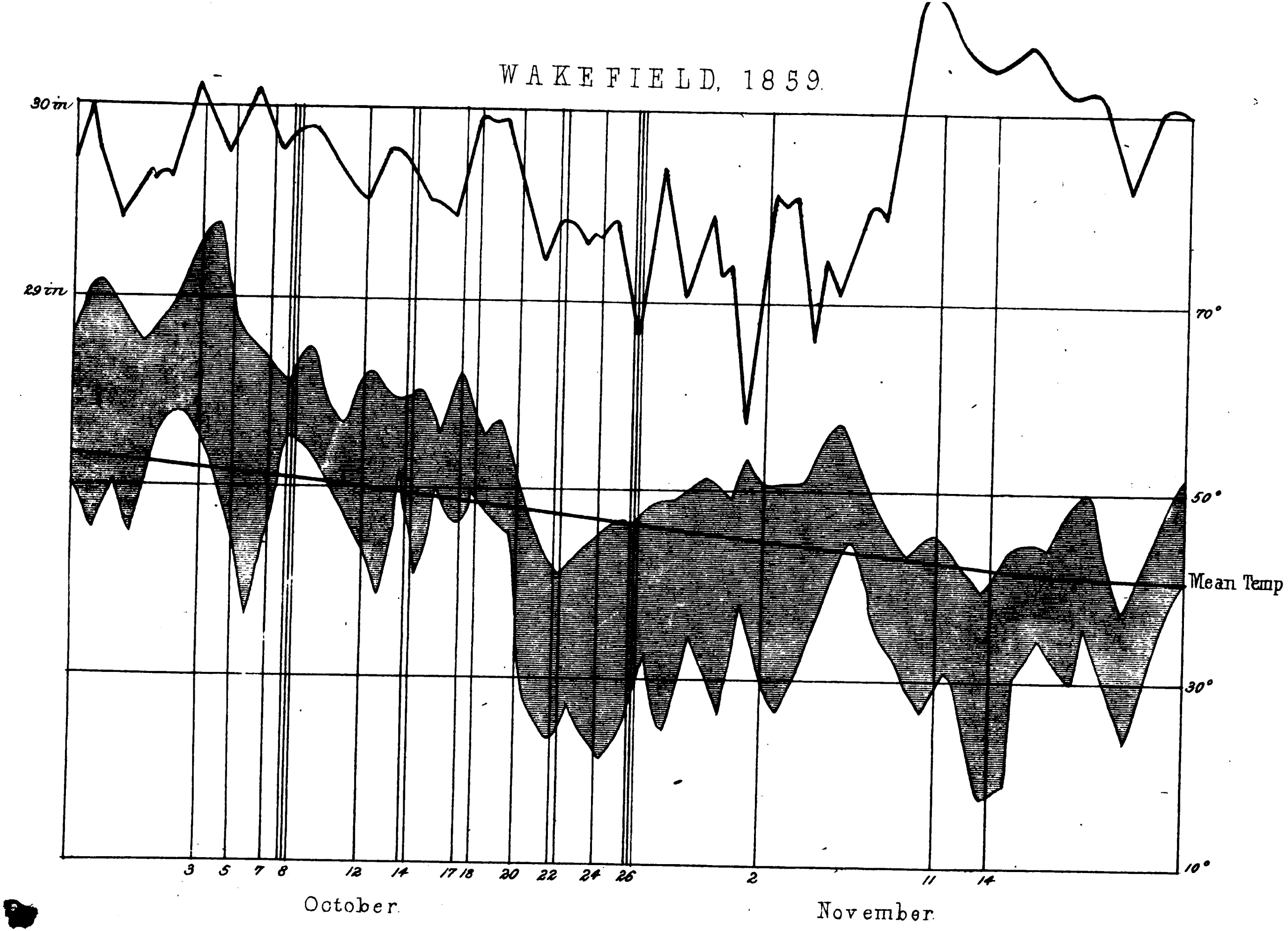
* See Plate I.

WAKEFIELD, 1859.



United Kingdom in 1859 gives a comprehensive view of the effects of the storms of wind of that year on shipping; and the Reports of the Government Inspectors of Mines supply the dates of the fatal explosions of inflammable gas in these mines for the same period. To these dates I have added those of eight fatal cases of suffocation in coal-mines by fire-damp and choke-damp, as such cases are as significant as explosions of the unusual presence of gas in the mine at the time of their occurrence. The marked coincidence in time of the greatest atmospheric disturbance during the year, and the occurrence of the greatest number of fatal accidents from gas in coal-mines, is striking and instructive.

In the year 1859, there were 139 vessels totally lost on our coasts, and of these wrecks, 77 took place between the 21st of October and the 9th of November. If this period of nearly three weeks be omitted, the total losses during the remaining forty-nine weeks of the year amount to 62, giving a weekly average of less than 2 total losses, whereas, the weekly average is 26 for the three weeks just mentioned.

The number of lives lost by shipwreck on our coasts in 1859 was 1,645, of which 877, or more than one-half, were lost in the same three weeks. The number of fatal accidents in British coal-mines, by accumulation of noxious gas, also rises far above the average in the month of October, 1859. There were in all 81 fatal accidents, of which 18 happened in October, leaving an average of less than 6 for each of the other months of the year.

The diagram shows that from the 1st to the 19th of October, the atmospheric pressure did not vary greatly, but the temperature of the air was far above the average (49° F.) for October. The effect of such a long sequence of very warm days and nights in checking the ventilation of mines is shown by the occurrence, within 18 consecutive days, of 12 fatal accidents in eleven different localities. These were:—

On October 3rd, Bilston, explosion;
„ 5th, Seacroft, Leeds, explosion;
„ 7th, Dudley, suffocation by choke-damp;
„ 8th, Pendlebury, Lancashire, explosion;
„ „ Prescot, St. Helens, explosion;
„ „ Robart's Town, Leeds, explosion;
„ 12th, Newport, Shropshire, explosion;
„ 14th, Aberdare, South Wales, explosion;
„ „ Heaton, Northumberland, suffocation by choke-damp;
„ 17th, Rowley Regis, Staffordshire, suffocation by sulphur;
„ 18th, Rowley Regis, Staffordshire, explosion;
„ 20th, Hampstead, Staffordshire, suffocation.

No shipwrecks in British seas are recorded between the 1st and 21st of October.

On the 20th, the temperature falls suddenly as much below the monthly mean as it had previously been above it. Much snow fell in North Wales, in the North of England, and in Scotland on that day. On the 21st several waterspouts were seen at the Isle of Man; and on the 22nd there was a very severe storm of thunder, lightning, and hail at Liverpool; several distinct shocks of earthquake were felt in Cornwall and in the west of England; and the barometrical column fell three-quarters of an inch.

Such were some of the premonitory symptoms of one of the most remarkable disturbances of the atmosphere in our time, which, beginning on the 19th of October, did not subside until about the 12th of November.

Having copied, early in November of last year, the sheets on which the direction and force of the wind, during the 25th and 26th of the preceding month, had been traced by the anemometer at the Liverpool Observatory, I concluded from these data alone, that the storm, which has now acquired a painful historical interest in connexion with the loss of the "Royal Charter" steamship, was a revolving whirlwind, or cyclone, travelling to the northeastward: an opinion fully confirmed both by my own researches and those of others. The anemometer shows that the wind began to blow here at noon of the 25th, from the eastward, veering continuously from east to north, up to 6, a.m. of the 26th, when there was a dead calm for an hour; after which the wind rose again at north, and veered rapidly to the northwest; increasing in force until 11, a.m., when it blew hardest here, the anemometer registering a pressure of 28 ℔s. Avoirdupois on the square foot. These shifts of wind prove the storm to have travelled to the eastward of north, and the central track to have been to the eastward of Liverpool. The mercurial column at Wakefield fell to 28·83 inches about the time that the wind was strongest here.

It may conduce to a just appreciation of the fluctuations of the barometric curve to state, that the sharp vertical depression of this curve, on the 26th October, is the barometrical exponent of 69 shipwrecks, involving a loss of 796 lives; and of three fatal colliery explosions, induced, in all probability, by the sudden overflow of inflammable gas released from the coal and "goaves," by the greatly diminished atmospheric pressure.

On the 31st of October, the mercurial column again falls below 29 inches, and at 9, a.m., of the next day reaches a minimum height of 28·39 inches. The corresponding depression in the curve symbolizes one fatal colliery explosion and fourteen shipwrecks. The localities and dates of the fatal explosions of gas in mines, from the 20th of October until the end of this remarkable period of stormy weather, are:—

October 22nd, at Washington, Durham;
„ „ at Dean Hall, Leeds;
„ 24th, at Crook, Durham;
„ 26th, at Longton, Staffordshire;
„ „ at Tipton, „
„ „ at Tolcross, West of Scotland;
November 2nd, at Royton, Lancashire;
„ 11th, at Donnington, Shropshire;
„ 14th, at Dukinfield, Cheshire.

At the conclusion of this paper Mr. Dobson made some oral remarks (illustrated by diagrams) upon Sir John Herschel's *Theory of Cyclones*, as described in the "Outlines of Astronomy." Mr. Dobson pointed out the chief features of cyclones, which a true theory was bound to account for; and he explained the principle by the operation of which the trade winds are caused. Sir John Herschel's theory was, that cyclones are formed by an extension of the same principle, which he called the *law of gyration*. But inasmuch as this principle is least efficient at the equator, where almost all the great hurricanes are first formed, and where they are most violent, it did not appear to Mr. Dobson to afford any satisfactory explanation; and, moreover, it fails altogether to account for the progressive motion of cyclones.

Mr. Dobson having announced that he had brought with him Captain G. Jinman,* a gentleman of much practical experience, who was an opponent of the *Circular Theory of Storms*, the President invited him to state his views, which he did with much clearness.

Captain Jinman said: As it would occupy too much time to detail all the circumstances which led me to doubt the truth of the *Circular Theory of Storms*, I shall be as brief as possible. Having frequently to pass over those parts of the globe where they are most frequently met with, I made myself thoroughly acquainted with all that had been written on the law of storms. And, previous to meeting a hurricane, I conceived that I was thoroughly posted up in the matter, and that I could manœuvre in one with all the ease imaginable. Practical experience, however, soon dispelled this idea, and convinced me that either I had yet much to learn, or else that the principles laid down by Redfield, Sir William Reid, Piddington, and others, were far from being correct. These principles are, that hurricanes, typhoons, &c., are nothing more nor less than great whirlwinds, winds blowing in circles round a calm centre; and, consequently, that this centre always bears about eight points from the direction of the wind—that near it will be found the greatest force of wind—that the centre is the principal part to be avoided on account of its being the most dangerous, from the sudden shifts of wind, or calm, and heavy cross sea to be met with at that point. The analysis of data obtained from ships which had been involved in storms from time to time tended somewhat to confirm these views; and, consequently, the *Circular Law of Storms* became *apparently,* an established fact. On these principles, rules were laid down for the guidance of shipmasters, by which, it was said, we might *easily* avoid the most dangerous part of a storm. To those whose avocations did not require them to put it in practice, the circular law appeared feasible enough; whilst the rules were so simple that a person of the most ordinary capacity, it was argued, might understand, and be able to apply them when necessary. As I have before observed, I made myself acquainted with these rules; and, as opportunities offered, I endeavoured to put them in practice. But the results were anything but satisfactory; for not unfrequently I appeared to meet with the centre (sudden shift of wind or calm) when I imagined myself to be far away from it. Feeling satisfied that there was something wrong, I resolved to examine carefully the various logs and other data which had been published. I was quite prepared to find *a few* discrepancies and anomalies; but I was certainly not prepared to find in the details of every storm the most glaring proofs of the fallacy of the circular law. Judge of my surprise when, on examining the works of Sir William Reid, I found that there was scarcely a track laid down on his charts which agreed with the shifts of the wind experienced by the ships, or at places involved. For instance, in the Barbadoes hurricane of 1831 the wind is reported to have blown for a time at Barbadoes, from the N.E., shifting suddenly to N.W., and bearing to west, S.W., south, and finally to S.E. and E.S.E.; yet the track on the chart is about W.N.W. Whereas, according to the rules laid down, the shift from N.E. to N.W. should give a due north track; from N.W. to S.W., a due west one; and the final shifts from S.W. to south, S.E. and E.S.E., about S. by E. If similar discrepancies or anomalies were to be found in a few cases only, I should have thought but little of the matter; but, as I have before observed, they are to be found in the details of every storm. Yet, notwithstanding those evident proofs of the fallacy of the principles advocated, we have been told that we may easily ascertain the track of, and avoid, a storm by adopting them. The most unqualified abuse has been poured forth on shipmasters in general, and those in particular who have had their ships damaged by storms. Mr. Piddington, the great cyclonist, has even gone so far as to imply that shipmasters are in the habit of running their ships into hurricanes. Seeing those proofs of its fallacy, I threw the *Circular Theory* aside, and scarcely rested night or day until I had got hold of what I believe to be the right clue. And I now assert, and am prepared to prove, that there never has been such a thing as a really *circular storm*, or one which will bear out the principles laid down by Redfield, Sir William Reid, Piddington, and others. Every hurricane or gale is formed by the joint action of two distinct currents of air flowing in opposite directions, and crossing each other at two points—one on each side of the centre. The two sides are distinct—seldom equally developed at the earth's surface—and seldom blow with equal force. The centre is not the most dangerous part of a storm; the greatest force of wind is invariably at some distance from the centre under the points of crossing, or where one current forces its way under the other. Sudden shifts of wind and calms are met with at the points of confluence as well as at the centre; and the greater portion of those ships which have been reported to have run into the centre never were near it.. A ship may stand into the centre of a storm, from one side, carrying topgallant sails, and yet be reduced to bare poles in passing out on the other. The consequence is that lives and property are being sacrificed, almost daily, by being plunged headlong into the most destructive parts of hurricanes, through those in charge being misled by the absurd and dangerous *Circular Theory of Storms.* In proof of this, I have but to refer to the case of the "Royal Charter." The anemometrical records of the Liverpool Observatory clearly show that previous to the calm, between six and seven. a.m., of the 26th, the greatest pressure was only 5 lbs. to the square foot; whereas, at noon, five hours after the calm, the greatest pressure was about 28 lbs. Consequently, a ship might have stood into the centre of that storm with a pressure of only 5lbs. on one side, and have met with a pressure of 28lbs. in coming out of it. If a storm is formed by one continuous current of air flowing round a centre, and if the sudden shifts so often reported occur only at the centre, how is it that the temperature and general appearance of the weather change so suddenly, as they often do, when a shift of wind occurs? I have known the thermometer to fall 20° in less than as many minutes, when a shift of wind has occurred in the Atlántic. Is it reasonable to suppose that the cool current entered was the same as the one quitted, and that it had changed its temperature whilst passing round the centre, or in the space of a few minutes? Surely not. The temperature, appearance of the weather, and force of wind, are seldom the same after the shift as before it; clearly proving, as I maintain, that a hurricane, or gale, is formed by the joint action of two distinct currents of air, and not by one continuous one. It may be said that ships have escaped by adopting the rules laid down. True, but it can easily be shown how two ships may be overtaken by the same storm; both follow these rules, and one may escape by so doing, whilst the other is plunged headlong into the heaviest part of it.

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* Captain Jinman's views have since been published in a separate form, in a work entitled "Winds and their Courses; or a Practical Exposition of the Laws which Govern the Movements of Hurricanes and Gales." G. Philip & Son: London and Liverpool, 1861.

Captain **Mortimer** agreed with much that Captain Jinman had said. He once thought that it would be very easy to sail out of a gale by the directions contained in the various works upon cyclones, and formerly had a great respect for Piddington's Horn-book; but experience had made him gradually lay them on the shelf. He believed that the spiral direction given to the wind arose in a great measure from the backing-up of clouds, and from the form of the coast line against which the wind impinged.

FIFTH ORDINARY MEETING.

ROYAL INSTITUTION, December 10th, 1860.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The following gentlemen were elected members:—

Mr. JAMES ALEXANDER,
The Rev. HERMANN BAAR, Ph.D.,
Mr. JOSEPH LEYLAND.

Mr. MOORE exhibited, on behalf of Captain Jinman, a remarkably fine group of the shells called *Magilus antiquatus*, from the Kooria Mooria Islands.

The PRESIDENT remarked that the gregariousness of the species was not generally known.

Mr. MOORE read a portion of a letter from Mr. S. Archer, Surgeon, H.E.I.C.S. (late of Rodney-street), dated from Cashmere, in which he mentioned the interesting fact that he there found in abundance the butterfly so well known in this country as the "clouded yellow" (*Colias edusa*).

The SECRETARY drew attention to an article in an Australian paper, the *Brisbane Guardian*, entitled "Cotton and Queensland," in which the eminent capabilities of that country as a cotton-growing district were advocated by Mr. W. Brookes.

The following paper was then read:—

ON LIFE ASSURANCE: REGARDED AS AN INVESTMENT.

By J. BIRKBECK NEVINS, M.D.,Lond.

The subject of Life Assurance is so extensive that I shall confine myself in the present paper to a very limited portion of it; and shall consider it chiefly in its bearings as an investment, under the following heads:—

1st. *The Value of Life Insurance, regarded simply as an Investment for such small sums as the Annual Premiums generally amount to.*

2nd. *The circumstances which have operated to limit the extension of Life Assurance, notwithstanding its acknowledged advantages.* And

3rd. *To point out the measures by which it appears that those obstacles may, to a great extent, be removed, and the benefits of Insurance more widely diffused.*

1st. *The Value of Life Insurance, as an Investment.*

The object of this section is to show ***the superiority of this method of investing small sums over any other that is within our reach;*** and, for this purpose, we shall take the ordinary circumstances under which Life Assurance is now carried on by offices of average respectability and standing; and assume that a person at 30 years of age is able to spare the small sum of £5 per annum, either as an Insurance Premium, or for investment in some other way. Now, the first thing that suggests itself will be the difficulty of finding an investment for so small a sum; and even five times this amount, or £25 a-year, would, probably, in most cases, be in the bank at a mere nominal rate of interest, or would remain at home, bearing no interest at all. But if it were invested in a Life Insurance policy, the smaller amount would at once insure the sum of £200, and the larger, or £25 a-year, the sum of £1,000, which would be payable immediately in case of death, and would, undoubtedly, form a good investment in that case.

But persons insuring their lives do not expect to die within the year, and thereby make such an excellent bargain; on the contrary, they look for an average, if not for a long, life; and more often think of the responsibility they incur in having to pay the yearly premiums, than of the post-obit advantage to their families from the receipt of money, which the paterfamilias has only handled in order to part with, to be seen by himself no more. We must, therefore, proceed on the supposition that a man will live for an average period, and have to sink his premiums for many many years to come, instead of seeing his wealth increase before his eyes, by the accumulation of yearly investments with profits, which he keeps—so to speak—in his own hands.

The following table will, however, exhibit this matter more clearly than any lengthened disquisition on the subject. I have assumed the age of 30 years for the reason that it is the most common one at present for commencing Insurance, *i.e.*, the age at which a family is beginning to grow up around the head of a house. The bonuses which are added in the third column are only such as many offices of a merely average character have proved themselves able to afford. I have also assumed, in the fourth column, that the difficulty of meeting with an investment for such small sums has been overcome, and that the money produces a steady return of 4 per cent., compound interest, which is as high a rate as can with safety be calculated upon, consistently with the essential feature of security.

The first column, then, contains the age of the person insuring.

The second, the number of years he has paid his premiums.

The third, the amount for which he is insured; which, after a time, begins to increase by the addition of bonuses.

The fourth contains the sum to which his investments would amount, year by year, with the constant addition of compound interest. And

The fifth shows the advantage in favour of Life Insurance as an investment, over the other security adopted.

The table ends with the 64th year, because at the age of 30, a healthy man has, on an average, the expectation of living 34 years to come, which will bring him up to 64; and all calculations of this kind must proceed on average principles. If a man at 30 lives longer than the 34 years which he may reasonably expect, he will, no doubt, to some extent, be a pecuniary loser by such a want of practical wisdom, as would be shown by living beyond the average age of men.

In order to avoid too many details, the calculations are only given for every second year; and the nearest shilling has been taken in the amount specified.

1st	2nd	3rd		4th						5th		
Age.	No. of Years Insured.	Amount Insured and Bonuses.		Investments, with 4 ℔ cent. Compound Interest, added.						Difference To Insurers.		
				Premiums, with Interest added.			Prems. actually paid					
		£	s.	£	s.	d	£	s.	d.		£	s.
30	1	200	0	5	0	0	5	0	0	Gains	195	0
32	3	200	0	15	12	0	15	0	0	„	184	8
34	5	200	0	27	2	0	25	0	0	„	172	18
36	7	218	5	39	10	0	35	0	0	„	178	15
38	9	224	14	52	19	0	45	0	0	„	171	15
40	11	231	3	67	9	0	55	0	0	„	163	14
42	13	238	1	83	3	0	65	0	0	„	154	18
44	15	245	0	100	3	0	75	0	0	„	144	17
46	17	252	3	118	10	0	85	0	0	„	133	13
48	19	259	12	138	7	0	95	0	0	„	121	5
50	21	267	0	159	17	0	105	0	0	„	107	3
52	23	275	0	183	2	0	115	0	0	„	91	18
54	25	283	0	208	5	0	125	0	0	„	74	15
56	27	291	5	235	9	0	135	0	0	„	55	16
58	29	299	17	264	17	0	145	0	0	„	35	0
60	31	308	8	296	14	0	155	0	0	„	11	14
61	32	313	1	313	11	0	160	0	0	Loses	0	10
62	33	317	15	326	2	0	165	0	0	„	8	7
64	35	327	7	352	14	0	175	0	0	„	25	7

Thus, it is evident that for *above thirty-one years he must be a gainer by investing in a life policy; and it is only in the last two or three years that he can be a gainer by adopting any other form of investment;* and even if he should be so unfortunate as to select an office which is not able to declare a bonus at all, it is still evident that he must invest for above 24 years without withdrawing a farthing of his funds, or sustaining any loss either of principal or interest, before his accumulation will amount to the sum for which he is insured.

The amount of risk which a person sustains during the 24 or 31 years that he must be investing before his savings can equal his life policy, may, perhaps, be placed in a still more striking light by reference to the Carlisle mortality table, from which it appears that if 5642 people are alive at the age of 30, fifteen hundred of them will die within 24 years, and two thousand within 30 years. What security, then, has any individual that he will not be one of the fifteen hundred or two thousand that die, and that he will ever have the opportunity of adding to his yearly accumulations until they amount to the policy, with bonuses, or even to the naked policy, without such additions?

With one illustration further, I shall conclude this part of the subject, and it is taken from an ordinary endowment table. At the age of 14 or 15 years, the time arrives for thinking how to provide premiums for our sons' education in business; and after the age of 20, our daughters sometimes evince signs of taking flight from the paternal roof, when an unappropriated hundred pounds may be a convenience towards adorning her wings and providing orange blossoms. Now an annual payment, from birth, of £5 16s. or something under £6, will secure a hundred pounds for the boy at the age of 14, and a payment of little more than £3 (£3 4s. 3d.) a-year will secure a like sum for a daughter at the age of 21; but the first premium multiplied by 14 only amounts to £81, *and we have, therefore, gained* £19 *in the hundred by that investment, and the girl's premium multiplied by* 21 *only amounts to* £67, *and we have, therefore, gained* £33 *in the hundred by that.*[*] Now, it is scarcely necessary to repeat that it is difficult to find an investment for such sums as the £6, or the £3 required for the premiums; and that if these amounts happen to be in hand without any special application in view, they may possibly disappear and leave no permanent fruits behind them; whilst, on the other hand, if an insurance premium must be paid by a certain day, or loss ensue, we may even make some little retrenchment or sacrifice to provide the amount, if it does not happen to be ready without such an effort being necessary.

Here, however, we may be met by the very natural question, "If the profit be so great to the insurer, how is the office enabled to carry on a business which shall be profitable to itself also?" and the answer is to be derived from many sources, but chiefly, perhaps, from this, viz., that it is very difficult for private persons who have other engagements to occupy their thoughts, to find profitable investments for small sums, such as have been mentioned; whilst it is easy for an office—whose business, from first to last, is connected with finance—to find investments for the hundreds or thousands of pounds which an accumulation of these small premiums may amount to. It will also be seen, by reference to the table, that the average expectation of life at 30 is 34 years; and, therefore, the office will, in the long run, make a profit of £25 7s. upon the average of the lives assured; so that the advantage to the individual insurer arises from his certainty of gain for above 30 years should he be one of the unfortunate two thousand who die early; whilst the profit to the office arises from the premiums paid by the remaining three thousand, who live, on an average, beyond the period, when their payments will be entirely swallowed up by their policies at the time of death.

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[*] The premiums are returned if the child dies under the age specified. If they are not so returned the annual premium required is much less than the sum here mentioned.

2nd. The circumstances which have operated to limit the extension of Life Assurance, notwithstanding its acknowledged advantages.

Having thus shown the value of Life Assurance, regarded merely as an investment, independently of the arguments in its favour, derived from the uncertainty of life, and the obvious duty of making a provision for our families at death, the question must now be considered—"What are the circumstances which are in operation to prevent a more general adoption of the practice?" These appear to be chiefly the three following, so far as I have been able to gather, either from conversation or from reading:—

1st. Imperfect knowledge of the real advantages which Insurance offers as an Investment.

2nd. Doubts as to the security of the Investment. And

3rd. The remote period at which the Investment becomes valuable; and its unmarketable nature in the mean time.

1st. I am under the impression that much remains to be done in the way of bringing the great pecuniary advantage of Insurance intelligibly before the public. The ordinary tables published by the different Insurance offices contain the materials for many of the calculations I have just laid before you; but I have only met with a single case in which even some of those advantages are put prominently forward, in a form appreciable by the ordinary public, without the necessity for making the calculations themselves. For instance—an ordinary endowment table furnishes the materials for discovering the gain of £33 in the £100 by insuring a child's life for 21 years; but it is necessary to make sundry calculations before discovering the result; and a large portion of even the provident public is able to appreciate an advantage of this nature when plainly stated, although it would not think of making the calculations, because such subjects are foreign to its daily pursuits.

2nd. But a more serious obstacle arises from a feeling of doubt about the safety of the investment—that is to say—about the ability of the office to meet its engagements when the day of reckoning eventually comes; which in this particular form of investment is only after the death of the insurer; and, therefore, after he has lost all power of lessening or remedying the evil, should the office prove to be unsound. This feeling of doubt can hardly be considered unreasonable on the part of the public when we look at the history of Insurance offices; and a few years since, it rose to such a height, that, in the year 1853, a Committee of the House of Commons was appointed to investigate the subject, the result of which was a most valuable blue-book on Assurance Associations, from which much of the materials of this paper is derived. At that date, the number of Insurance offices was estimated at about 100; but "between 1844 and 1853 no fewer than 311 Insurance companies of various kinds were provisonally registered, of which only 96 continued to exist in the latter year."—Report, p. 430. Since that date, a large number of Insurance offices have come into existence, and have also disappeared; and the general result is, that from the year 1844 to the commencement of 1860, 146 Life Insurance offices have wound up their affairs, or have come to an end in some other way.*

In addition to this circumstance, a considerable number of the older offices did not publish any statement of their affairs, and the insurers were, therefore, entirely in the dark respecting them; and the statements which many of the new offices did publish, in compliance with the Act of Parliament, were of such a nature that Mr. Whitmarsh, the Registrar of Joint Stock Companies, informed the Committee that "a more unexplainable thing can hardly be, than the balance-sheets returned."—"I do not suppose that one person in 500 could understand any one of those balance-sheets, as they are made up."—"I should say they are rather calculated to mislead than to inform."—Report, p. 5.

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* *i. e.* 78 between 1844 and 1856 (see "Hand-book of Insurance," p. 61), and 68 between 1856 and 1860 (calculations from the lists in the medical directories).

It can scarcely be a matter of surprise, after this, that there should be a feeling of insecurity in the public mind with reference to Insurance offices.

It is, however, in the highest degree satisfactory to peruse the evidence of first one, and then another, of the witnesses examined before the Committee; for their independent testimony all leads to a result very different from what was expected when the Committee commenced its labours. The witnesses were actuaries and others of the highest standing, and represented both the oldest and the youngest of the Insurance offices; and amidst all the dissatisfaction with details, and the faults which they unsparingly exposed, *their evidence was almost if not quite unanimous, that the general condition of Life Assurance offices, with the exception of the* West Middlesex *and the* Security Mutual, *was sound and solvent; and that, with very few exceptions, the parties insured in them enjoyed perfect security; and when further pressed by the Committee to state whether they had known any instance of a Life Insurance office failing to meet its engagements, the answers were, almost without an exception, that they had not known of such an instance; the shareholders might have suffered, and the company might be ruined, but it had still met its engagements,* or transferred its business to another more careful or more successful company. A few cases were mentioned by one witness in which fraudulent companies had obtained a single premium from various persons, and then broken up; but, even he added, "the only case of a second premium I ever heard of was that of B. G., but I believe his premiums were due half yearly."—Pateman: Report, p. 279, a. 3068.

The evidence, also, of the witnesses was to the effect that, generally speaking, the accounts published by the companies were capable of being understood, and although they admitted of very great improvement, they still contained much information of value to an actuary in judging of their condition. Since that date, the statements put forward, year by year, by the different companies are much more intelligible than formerly to ordinary readers; and an element has lately been introduced into the reports of some of the offices which is of primary importance with reference to the feeling of security. In the report of an Insurance company, published about 12 months since, the auditors certified that they found the books correctly kept and accurately balanced, and all the vouchers right enough; but they added that they had no means of knowing whether the assets of the company existed anywhere except in the books, for they had no access to the deeds or other securities held by the company; and they could, therefore, only say that everything was correct as far as the books showed it. On presenting this report, they were immediately authorised to examine the securities as well; and, at an adjourned meeting, they reported that the securities, as well as the books, were correct—a most important question both for the shareholders and the insurers. The primary importance of such a scrutiny—not only into the books, but also into the securities held by the company—has also been strongly insisted upon, and carefully carried out, by an actuary of the highest eminence in this neighbourhood; and the result has confirmed the well-merited confidence which the public has reposed in the company under his guidance. We may, ere long, expect to see such an examination a regular and essential part of the report of every office, that desires to stand well with the public.

The evidence which has thus been laid before you appears amply sufficient to remove any doubts as to the soundness of the security of a Policy of Life Assurance; but there is still another means of satisfying the doubtful, which will come more appropriately under notice after taking the third objection to Life Assurance, viz.:—

3rd. *The unmarketable nature of the Investment.*

I believe that this is an objection which weighs strongly with many persons of a thoughtful and provident character, who are fully alive to the importance of providing for their families, and have considered the subject of Life Assurance as a means of doing so. Their objections may be put together in some such form as the following:—"I am at present able to insure my life, but I have no security that I shall continue able to pay the premiums; and, in that case, what I have paid will go for little or nothing; and although I have children dependent upon me now, for whom I wish to provide, they may be grown up and independent of me before I die, and I may wish to give up my policy; but if I do, I shall get nothing for it, for the companies always take advantage of people who want to sell their policies; or it may be extremely important for me to raise money upon my policy, but it is a matter of such bargaining and delay, besides the loss, that I will rather save my money, and have it by me, than insure my life."

Such as these are the objections which I have frequently heard raised by thoughtful persons upon whom Life Insurance had been urged; and it will be observed that they all turn upon the question of the difficulty of obtaining a fair surrender price for a Policy of Insurance. There is much to be said for the office as well as for the insurer in explanation of this difficulty; but I believe that there is a prevailing feeling, whether well or ill founded, that the offices do not in general give a fair surrender value for a Policy of Insurance; and that they take advantage of the position in which the insurer is placed to offer him terms which he feels assured are much below the real value. This feeling operates, I believe, very prejudicially to the extension of Insurance amongst persons who might otherwise insure for moderate sums—such as constitute the staple of the business of many of the younger offices—for not only does the anticipation of it prevent some persons from insuring, but the annoyance which is experienced in a negotiation for surrendering a policy, leaves the insurer with little friendly feeling towards the office which he thinks has dealt ungenerously, if not unjustly, by him; and he is more likely to dissuade a friend from insuring in that office than to urge him to do so; and the company not only loses him as an insurer, but makes him a passive, if not an active, opponent.

It must be confessed that the view of the case which is thus taken by the insured finds countenance in the evidence given before the Committee of the House of Commons; for in answer to questions, several of the witnesses drew attention to the difference between the real value of a policy and the amount which the offices generally give; and whilst stating that the real value of a policy, a few years in existence, is in round numbers, about half the amount of the premiums paid, they state that the offices generally only give about two-thirds of the real value, or one-third, instead of one-half, the premiums actually paid; and that some years must elapse before they will give anything for them at all. These lapsed policies, for which nothing is given, form an important item in the accounts of some offices; and I have just seen the report of a company which has been 14 years in existence, and which states that every claim from deaths that has occurred during the whole period of its existence has been met by the premiums paid upon lapsed policies, and there is still a balance of above £7,000 in hand from this source, *i.e.*, the insurers who will derive no future benefit from the office have borne the whole of the society's losses during 14 years, and still leave it a balance in hand.

Thus far for the complaints of the public. On the part of the companies, it is due to state that these lapsed and surrendered policies, although apparently a source of unalloyed profit, are really, in one sense, a serious loss to the company; and, moreover, that the profit is nothing, in the long run, as compared with the loss. This apparent contradiction is easily explained by reference to the mode of fixing the premiums. For the sake of convenience the amount is stated as a definite sum, to be paid year by year, but it really consists of two portions which must be carefully kept distinct after they are once paid into the office. One part of the premium is absolutely necessary for covering the risk of the life, and meeting claims by death when they become due, whilst the remainder of the premium, called the "loading," is for the purpose of defraying the expenses of management, &c., and yielding a profit to the company. Now, it is evident that if a policy lapses altogether, or is bought by the company at £50 below its real value, it gains a present advantage of this amount; but if the annual profit derivable from that premium was £10, and the insured had a reasonable prospect of living 30 years, the profit to the company would have been £300. It will, however, have lost this by the cessation of the policy; so that whilst it makes a present gain of £50 it incurs a loss of £300, which may well account for the reluctance of offices to encourage the surrender of policies.

Persons who wish to surrender their policies often think them of more value than they really are, from overlooking the circumstance that their lives have been insured already for many years, and that they ought, in all fairness, to pay for the security they have so long enjoyed; they have, therefore, no more right to expect a return of anything near the amount they have paid, than a person insured against fire would have to expect the return of his premium because he had had no fire on his premises.

It must, however, be admitted that the insurer has grounds for dissatisfaction in receiving only two-thirds of the real value of his policy, even though the company makes far less profit on the transaction than he is apt to imagine; and it becomes a question which appears to me deserving of consideration, whether a more liberal policy, on the part of the offices themselves, would not result in substantial profit in the long run, instead of loss, by facilitating the surrender of policies by the insurers. If the companies published, along with their other tables, one containing a fair and full value for policies which had run so many years, and made these amounts payable, not after a bargain with the company but on demand, or at a short fixed notice, it appears to me that several very important purposes would be gained, of as much value to the office as to the insurer. In the first place, it would give the best possible answer to any one who doubted the stability of the office; for, on demand, he could obtain the stipulated sum, and satisfy himself, by this means, of its solvency, if he considered the satisfaction of his doubt worth the sacrifice which he would incur in withdrawing. In the next place, it would make every life policy a document of known marketable value; for, if tendered as a security, the receiver would be quite independent of everything except the amount of the policy, and the numbers of years it had run. He need not consider whether the premiums were likely to be kept up or not; for, if they lapsed, he would still, on demand, obtain the amount due for the length of time that it had been in force. The insurer would be saved the feelings which now so often accompany the surrender of a policy; and being shown that he had received the fair value for it, he would probably be induced to re-insure in the same office, when the temporary circumstances had passed which occasioned his withdrawal; and being freed from the fears which many men now entertain lest they should become unable to keep up their premiums, and so sustain loss, he would cease to hesitate about insuring himself, and would probably promote, rather than hinder, the assurance of others.

To this it is objected, and the objection undoubtedly deserves serious consideration, that an Insurance office is, to a great extent, a provident institution; and that it might prove an injury to the insurers by producing improvidence, if policies could be surrendered with ease for an amount which might appear considerable. But it must be remembered, that under any circumstances the insurers can only expect about half the premiums actually paid; and the loss in surrendering a policy will therefore always appear considerable, and sufficient to prevent any but very thoughtless persons from surrendering their policy for the small amount it could yield: and if the public was more thoroughly instructed in the great pecuniary gain derived from Insurance as an investment, as shown in the early part of this paper, the number of those who would kill the goose that lays such golden eggs, for the sake of the surrender price of the policy, would be very small indeed. It is my firm conviction that liberality in this respect on the part of the companies, combined with tables well drawn up shewing the great pecuniary advantage of Insurance, would induce a very considerable addition to the number of Insurers; whilst the proportion of those who discontinue their policies would be very small, and would consist, still more than at present, of those only whose circumstances compelled them to make the sacrifice.

Some offices have indeed introduced the principle of allowing a policy to expire by the cessation of payments, and granting a new one of the value of those already made; but although this is a valuable addition to the privileges of insurers it does not render a policy any more marketable or available as a security, because the holder must still wait for the death of the party before it becomes cash. There is a marvellous charm in the words,

"On demand, I promise to pay,"

which is not possessed by any talisman, ancient or modern.

In the discussion which followed, several members urged the importance of publishing tables of the surrender value of policies; upon which Mr. Boult replied that for his own part, he was rather in favour of such a plan; but it had not the general approbation of Insurance offices at present; and there existed a strong feeling against making surrenders too easy, lest it should encourage improvidence and the too frequent discontinuance of insurances on slight grounds. He repudiated the notion that policies had no market value; for if a person wished to sell one he could send it to a London auction mart and it would fetch its value—"The value of the thing being the money it will bring."

Dr. Nevins replied on the question whether the auction price offered for a policy did represent its true value, and showed that it did not, from the very nature of assurance principles. The entire safety of assurance depends upon the fact that, taking a large number of lives together, the good and the bad will balance each other, and, on the whole, a safe average can be calculated upon; but if a single life only is insured it may prove very good or very bad, and the transaction becomes a speculation, and not a matter of safe calculation. Hence arises the unsaleable character of policies in the market, as the purchaser of a single policy becomes a speculator on that particular life; whilst the company, having an average surrender value, would take the risk of good and bad together, and transact legitimate business instead of entering upon a mere speculation.

The following paper was also read:—

ON AGASSIZ' VIEWS OF DARWIN'S THEORY OF SPECIES.*

By CUTHBERT COLLINGWOOD, M.B.,Oxon, F.L.S., &c.

WHEN the subject of Darwin's Theory of the "Origin of Species" was brought before this Society, a short time back, the paper of M. Agassiz, in the "Annals" of September, 1860, in which he severely criticises the views of Mr. Darwin, was prominently set forth, and characterized as "quite unworthy of so distingushed a naturalist." I then ventured to differ from the writer in this general estimate, and also to demur from the representation given of his fundamental statements; and I agreed to the invitation to defend the remarks of M. Agassiz at some future time. Since then, I have been waiting for an opportunity of laying before you a few observations upon this subject, premising that a more careful perusal of M. Agassiz' criticism has only confirmed me in the opinion I then expressed, viz., that I considered it to be one of the most conclusive and formidable (against Darwin's theory) which had yet appeared.

I know not how I can satisfactorily show the value of M. Agassiz' paper, except by taking up his principal positions *seriatim*, and endeavouring to prove their truth and logical accuracy; and this I shall hope to do, dwelling more particularly upon those points which were specially singled out for objection. Moreover, I shall not enter farther upon a discussion of Mr. Darwin's views than we are necessarily led by the subject-matter of Agassiz' criticism.

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* This paper is an answer to certain statements made at the Second Ordinary Meeting of the Society, some of which will be found printed, commencing p. 42 of this volume.

And here let me premise that the criticism in question is one among a very few, which, proceeding from the pen of a profoundly scientific physiologist, and accurate observer, fairly addresses itself to the scientific and physiological aspects of the question—not repeating and corroborating Darwin's own somewhat easily appeased doubts, but attacking it at points which were not hitherto observed to be weak, and arising, as it might be almost said, accidentally, from some considerations relative to the degrees of individuality, and specific differences observed among Acalephs. There does not appear to me to be a word in this paper unworthy of, or inconsistent with, the character and attainments of the author of "An Essay on Classification," a work which, in my humble opinion, is a noble contribution to zoological enquiry, and is characterized by a solidity and accuracy of statement—a conformity with observed phenomena—a chain of logical sequence,—which favourably contrasts with the necessarily imperfect hypothesis of Mr. Darwin—with its gaps—its assumptions—and its demands upon our faith.* And this fact alone renders it, *à priori*, unlikely that the man who wrote the former should be guilty of anything approaching to petulancy or absurdity when reviewing the latter.

It would be presumptuous in the highest degree in me to consider it necessary, under ordinary circumstances, to stand forth as the apologist for one so eminent in every way as Louis Agassiz—one who is an ornament to science, and the pride of the country of his adoption. I only feel called upon to do so on your invitation, and because in the review in question he has been charged with dogmatism and intentional obscurity. Did I think that these charges could be substantiated, I would at once lay down my pen; but I firmly believe that a candid enquiry will result differently.

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* It is, perhaps, necessary to state here, lest I should be misunderstood, that although by no means able to subscribe to the Darwinian hypothesis, I would not wish (as some appear to do) to condemn the whole theory as visionary and mischievous. Neither theory is capable of direct *proof*, and both are so dependent upon knowledge (not only the knowledge of an individual, but also the accumulated knowledge of an age), that I think it would betray an unworthy assumption of wisdom on my part wholly to reject the new one, virtually unheard and untested.

M. Agassiz begins by advocating the idea—"That while species have no material existence, they yet exist as *categories of thought*, in the same way as genera, families, orders, classes, and branches of the animal kingdom;" and again, "that all the natural divisions of the animal kingdom are primarily distinct, founded upon different categories of characters, and that they all exist in the same way,—that is, as *categories of thought embodied in individual living forms.*" Now, in all these expressions, I can see nothing obscure nor petulant—but, on the other hand, I *do* see the accurate reasoning of a philosophic mind, and a consistency in the support of a fundamental principle; which principle is in complete antagonism to Darwin's theory; so that there is no possibility of amalgamating the two ideas. Agassiz has, in all his works, maintained the same principle, and no one can reasonably object to his re-stating it on this occasion. But since it is complained that it is obscurely stated, let us examine whether it be not in truth logically and tersely expressed. What is a category of thought? I reply that it means a mental abstraction, in which all the predicates and all the attributes of the idea of species are arranged in an orderly series. Species exist in individuals—all the *similar* individuals existing at one time, embody the idea of a species; the individuals live—they are *objective*—they thrust themselves upon our notice as material beings—but something more than this *mere existence* is arrived at by our reasoning faculties, which *subjectively* infer that these forms represent an *idea*, which we may reasonably conceive was present with the Creator, when it pleased Him to make them, and that idea is *species*. Thus we arrive synthetically through all the characteristics of species, so comprehensively described by Agassiz in his "Essay on Classification," at the generalization with which we imagine the Creator to have set out. Species, then, is an idea, not an entity; but an idea which sprang from the Eternal Mind.

"As the community of characters," says Agassiz, "among the beings belonging to these different *categories* arises from the intellectual connexion which shows them to be categories of *thought*, they cannot be the result of a *gradual material* differentiation of the objects themselves." I quote this passage because it was imagined, not only that it conveys no sense, but it was even suggested that the author wittingly wrote nonsense. Such a notion is to me incomprehensible; but, farther, I see in it a condensed chain of logical reasoning, which demands close study, and no superficial glance, to appreciate its whole import. The author has just been speaking of the several great plans upon which it has been demonstrated that the animal kingdom has been constructed. It has been shown by the labours chiefly of Owen, Huxley, and others, that no one plan can be constructed to which all animals are reducible. No *invertebrate* animal can be shown to be formed agreeable to the *vertebrate* plan; the molluscan and articulate plan have scarcely anything in common; and the cœlenterata and protozoa, moreover, differ in plan from either, and are probably not even mutually reducible. Here, then, community of *origin*, and community of *characters*, are not synonymous terms. There is *community of characters* in a *class*, but he distinctly asserts that "classes are founded upon different modes of execution of these plans, and, therefore, they embrace representatives which could have no *community of origin*." Moreover, in the sentence I am examining, it must be borne carefully in mind that there is an antithesis between the abstract idea, or category of thought, on the one hand, and the living embodiment, or individual forms, on the other. Bearing this in mind, let us now read the sentence—"As the community of characters among the beings belonging to these different categories (*i.e.*, great branches of the animal kingdom, each formed upon a different plan) arises from the intellectual connexion which shows them to be categories of thought (in the sense explained above) they (that is, these different categories or abstract plans, embodied in vertebrata, mollusca, articulata, &c.) cannot be the result of a gradual *material* differentiation of the *objects* themselves." Here, the antithesis is between *intellectual,* in the first part of the sentence, and *material,* in the second—between *categories of thought* (or the idea of species) in the first part, and the *objects* (or the embodiment in living forms) in the second.* For Mr. Darwin tells us that the gradual material differentiation of individuals has given rise to all the *great plans* of structure. The whole sentence is pregnant with meaning—not a word is employed which has not a definite and necessary connexion with what precedes or with what follows; and the simple difference between the position of the writer and that of the reader is this, that Agassiz wrote the sentence with a full and thorough appreciation of all the bearings of the subject, every word being fraught with meaning in his mind, whereas, his reader having less grasp of the subject, has, necessarily to learn it by degrees, and by a dint of study of its contextual relations.

A few remarks may here be appropriately introduced upon the subject of these great plans, which appears to me to be one of the last importance.†

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* "The leading objection of Mr. Agassiz is likewise of a philosophical [metaphysical] character. It is, that species exist only as *categories of thought*—that, having no material existence, they can have had no material variation, and no material community of origin. Here, the predication is of species in the subjective sense, the inference in the objective sense."—*Prof. Asa Gray, in Atlantic Monthly Magazine, October*, 1860.

† Nothing can prove more certainly the *natural* character of these four distinct plans than the fact that Von Baer and Cuvier, each of them independently arrived at the same conclusions concerning them—Von. Baer, through the study of developmental changes, and Cuvier, by means of a close attention to the anatomical structure of animals.

These great plans of animal structure are not mutually reducible. However animals of different branches may agree in their *external* characters (as I showed at length in a paper read before the Society last session) no comparison can be instituted between their internal structure. No *series of forms* can be constructed, passing insensibly from one great branch to another. The highest forms of one branch are superior to the lowest forms of the branch next above it in organisation, but there is no *community of characters* between the two—each adheres to its own special type or plan. Thus, cephalopods may, in some points, be regarded as intermediate between mollusca and fishes, but the highest cephalopod is superior to the lowest fishes; nevertheless, as Von Baer remarks, "metamorphose a cephalopod as you will, there is no making a fish out of it, except by building up all the parts afresh." Darwin himself recognises this difficulty. Hence he says, in summing up, "I believe that all animals have descended from at most only *four* or *five* progenitors." But at this stage of his argument, the demands of his theory are imperative, and he adds—"Analogy would lead me one step further, namely, to the belief that all animals *and plants* have descended from some *one* prototype;" and arguing from what we must be excused from designating somewhat vague ideas of a *community of composition*, he adds this climax—"Therefore, I should infer from analogy that, probably, all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed."*

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* Much stress has been laid, in derivative hypotheses, upon the changes which the organism undergoes in embryo; and, truly, it must diminish our feeling of incredulity in, and repugnance to, the theory of derivation, when we reflect on these changes. *A priori*, it does not seem more incredible that some adult species should have arrived at their present condition by having passed through inferior forms during immense periods of time, than that embryos should (as we know they do) pass through various representative forms of lower types of animal life, previous to arriving at their permanent condition. Embryology shows us

Let me now proceed to the examination of Agassiz' further arguments. I pass over his caustic remarks upon the confusion of ideas implied in the general term, *variability of species;* and I must also necessarily pass by his categorical contradiction of many of Darwin's fundamental statements; but never was a theory more sorely beset than is that of Darwin by the repeated assaults of such a giant in palæontology as Agassiz. Statement after statement, by which the whole theory hangs together, is assailed and impugned—stone after stone of the Darwinian structure trembles before the battering-ram of the champion of species. Out of twelve such reiterated attacks, ten of which are purely palæontological, and stand unchallenged, only one has called for remark, and that one, perhaps, the least important. Nevertheless, believing, as I do, that Agassiz has written no line without an object, I am bound to bring it before the tribunal of criticism. He says—"He (Darwin) would have us believe that animals acquire their instincts gradually, when even those that never see their parents, perform at birth the same acts, in the same way, as their progenitors." Now, this appears at first sight to be such a truism, that it seems unnecessary either for Agassiz to state it, or for me to defend it. But we must not forget that Agassiz writes with especial reference to an argument before us all, viz., Darwin's work on the "Origin of Species." We must, therefore, consider this passage relatively to that work. In chapter 8, we read—"If we suppose any habitual action to become inherited, then the resemblance between what originally was a habit, and an instinct, becomes so close as not to be distinguished;" and again—"Under changed conditions of life, it is at least possible that slight modifications of instinct

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that there is no *natural barrier* to development, as long as that development is confined to cognizable gradations. But we have yet to learn that the embryo of a vertebrate animal ever exhibits the articulate or molluscan type; and the primary distinction thus implied casts doubt and difficulty upon the other cases in which the transition *seems* more easy and simple.

might be profitable to a species; and if it can be shown that instincts *do* vary, ever so little, then I can see no difficulty in natural selection preserving, and continually accumulating variations of instinct to any extent that may be profitable." Here, then, Darwin compares instinct to habit, and argues concerning it as he would argue concerning habit. But *instincts* exhibit themselves at the very threshold of life, before it is possible for *habit* to be developed, which presupposes some experience. Hence, how can we "believe (to use the words of Agassiz) that animals acquire their instincts gradually, when even those who never see their parents, perform at birth the same acts, in the same way, as their progenitors?" It will be seen, that in this connexion, the argument is not carping nor superfluous, but forcible and cumulative.

I now pass to a more important part of the subject, namely, the remarks of Agassiz in regard to the assumed connexion between *affinity* and *genealogical relationship;* and, in the first place, I cannot construe his observations in any way so as to make him argue that "similarity between adult animals is but an agreement in a single stage; and if agreement in a single stage be sufficient to prove genealogical relationship—then, since the embryos of very distinct animals are much alike, there must be a close relationship between these very distinct animals." What he *does* say is this—"There is nothing *parallel* between the relations of animals belonging to the same *genus* or the same *family*, and the relations between the *progeny of common ancestors.* In the latter case, we have the result of a physiological law regulating reproduction, and in the former, affinities, which no observation has thus far shown to be in any way connected with reproduction." Here we have an argument, in which the opponent challenges Darwin for *facts* in support of his hypothesis that *affinities* among animals are evidence of *genealo-*

gical relationship. He proceeds—"The most closely allied species of the same genus, *or* the different species of closely allied genera, *or* the different genera of one and the same natural family, embrace representatives which, *at some period or other of their growth,* resemble one another more closely than the nearest blood-relations; and yet we know that they are only *stages of development* of different species, distinct from one another at every period of their life." Here is not a word about similarity between *adult* animals, but the whole argument is based upon *developmental* changes, and the *reductio ad absurdum* is not proven. Thus, proceeds Agassiz, "The *embryo* of our common freshwater turtle (*Chrysemys picta*) and the *embryo* of our snapping turtle (*Chelydra serpentina*) [distinct genera, be it observed] resemble one another far more than the different *species* of Chrysemys [a single genus] in their *adult* state; and yet not a single fact can be adduced to show that any one egg of an animal ever produced an individual of any species but its own." A great and overwhelming fact against the theory of derivation, since it proves that the character of the species impressed upon the germ from the beginning, by hereditary descent, is dominant through all the various changes, analogies, and differentiations through which the embryo passes; never swerving from its undeviating course, except by the force of unwonted disturbing causes, and even then returning by the shortest cut to its original form; so that, as Agassiz elsewhere happily expresses it, "while *individuals* are perishable, they transmit, generation after generation, all that is specific or generic (or in one word *typical*) in them, to the exclusion of every *individual peculiarity,* which passes away with them." How different this from what Darwin's theory would demand of us, which tells us that it is just these *individual peculiarities* which are preserved, and, by their accumulation, *alter* the type.

But the head and front of Agassiz' offence lies in the following illustration. He says—"A young snake resembles a young turtle, or a young bird, much more than any two species of snakes resemble one another, and yet they go on reproducing their kinds and nothing but their kinds; so that no degree of affinity, however close, can, in the present state of our science, be urged as exhibiting any evidence of community of descent." There is no man living who has more right to speak authoritatively on embryology, particularly upon that of the Reptilia, than Agassiz. For the first four years of *my* existence, *he* dwelt, as a disciple, in the house of Ignatius Döllinger, the master of the great Von Baer, and of Pander, and the father of the science of embryology. His laborious and marvellous work on the "Embryology of the Turtle" (Boston, 1857), which forms a portion of the "Contributions to the Fauna of the United States," is a monument of science and industry, of which any nation may justly be proud. No author has more completely, more thoroughly, or more exhaustingly investigated this difficult branch of physiology than Agassiz; and his assertions on this subject are entitled to the very highest respect. It is conceded that when Agassiz writes of a *young* snake and a *young* bird, in this passage, he refers to an embryo snake and an embryo bird, and, indeed, to a *young* embryo. I can only, however, bring the authority of other eminent physiologists to corroborate the assertion of Agassiz, which, *to non-physiologists*, no doubt, appears somewhat startling. I quote the following passage, therefore, from "Carpenter's Comparative Physiology," p. 628—"All the most important parts of the apparatus of organic life, and even the fundamental portions of that of animal life, are developed upon the same general plan in all vertebrata; and the *special* peculiarities of each class only *gradually* evolve themselves. The conditions under which the alimentary canal, the heart and blood-vessels, the liver, the corpora Woolfiana, the vertebral column, the nervous centres, and the eye and ear, first present themselves, exhibit no essential difference in the fish, reptile, bird, or mammal." Again, "the history of development," says Von Baer, "is the history of a gradually increasing differentiation of that which was at first homogeneous." The fundamental type, he elsewhere explains, is first developed, and afterwards more and more subordinate characters appear. In these passages is stated, then, the fact, well known to physiologists, which Agassiz has summed up and illustrated in the line in question.

But is the objector and doubter aware that Darwin himself mentions this very fact, quoting Agassiz as an authority. At p. 439 of the "Origin of Species," we read—"It has already been casually remarked that certain organs in the individual, which, when mature, become widely different, and serve for different purposes, are in the embryo exactly alike. The embryos, also, of distinct animals, *within the same class*, are often strikingly similar; a better proof of this cannot be given than *a circumstance mentioned by Agassiz, namely, that having forgotten to ticket the embryo of some vertebrate animal, he cannot now tell whether it be that of a mammal, bird, or reptile.*" Not, however, that this is anything new—for, a dozen years ago, Agassiz wrote—"To deny the reality of natural groups because of their early resemblances would be to take the resemblance for the reality. It would be the same as saying that the frog and the fish are identical, *because at one stage of embryonic life, it is impossible, with the means at our command, to distinguish them.*" And again, in another place—"Hence, the embryos of different animals resemble each other more strongly when examined in the earlier stages of their growth. We have already stated that during almost the whole period of embryonic life, the young fish and the young frog scarcely differ at all; *so it is also with the young snake compared with the embryo bird.*" The truth is, that at a certain period, the embryo of a snake and the embryo of a bird *are* as much alike as the embryos of two snakes, and affinity *is* thus at fault in indicating relationship, which is, in fact, the argument of Agassiz, and one which cannot be gainsaid. This being the major proposition, the minor is, of course, included in it, namely, the assertion of Agassiz that "an *embryo snake* resembles an *embryo bird*, more than two *adult snakes* (of different species) resemble one another." The differences between embryos should undoubtedly be compared among themselves; but, nevertheless, if such differences are inappreciable in comparison with the distinct specific differences observed in adults, there can be no reason why the argument should not be strengthened by such a comparison.

There is yet one more portion of the paper of M. Agassiz, in which he has, as I conceive, been seriously misunderstood; and, it is a point not inferior in importance to any of those upon which I have already touched. Returning to the subject of *individuality* among Acalephs, with which he commenced the paper, he proceeds to specify the very remarkable modifications which the great "mystery of organic life" exhibits. First, he describes *hereditary individuality* as exhibited in all the higher animals. This is rare in Acalephs, and only exists in the Ciliogrades and some Pulmograde Discophoræ. Second, *derivative*, or *consecutive individuality*, such as occurs in the Nudibranchiata, which, from a single egg, produce more than one individual; this also occurs in such Medusæ as have what is termed an *alternation of generations*. Thirdly, *secondary indviduality*, such as is inherent to those individuals arising as *buds* from other individuals, and remaining connected with them (as in the fixed Polyparia); and, fourthly, *complex individuality*, in which such a community acts as a single individual, while each individual member may perform distinct acts of its own. This last occurs as a character of the Siphonophoræ among Acalephs—the Physogrades of De Blainville.

There is thus among Acalephs, great diversity of individuality; and, moreover, a similar diversity is observed in the specific differences among them; or, in other words, a greater or less degree of polymorphism is remarked. With Ctenophoræ (or Ciliogrades of De Blainville) this polymorphic tendency is at a minimum; for here, not only are the individuals composing the group closely similar, but being all hermaphrodite, there is not even the polymorphism arising from difference of sex. *This*, however, *does* occur in the Pulmograde Discophoræ (to which our naked-eyed Medusæ belong), and sometimes the variations are very striking, as in Aurelia, one of the covered-eyed division, which has received from writers the names, Aurelia lineolata (Peron), A. radiolata (Lamarck) A. granulata, A. rosea, A. surirea, A. purpurata, Medusa purpurata (Penn), and Biblis Aquitaniæ (Lesson), the species indicated being in every case *Aurelia aurita* (Forbes). Deviations from the normal number of parts constitute another source of polymorphism. Next, the cycle of individual differences embraces two distinct types of individuals—the *Medusa* type and the *Hydra* type. *One* of these types may exhibit more or less diversity, there being frequently *two* kinds of Hydra united in one and the same community; or (though more rarely), two kinds of Medusæ, as among the Siphonophoræ (Physogrades). Thus, in the Diphydæ, which appear like pieces of transparent glass, and which were imagined by Cuvier and others to consist each of two distinct animals, always united, although separable with impunity, Professor Huxley shewed (Phil. Trans., 1849) that they consist of two constantly associated, though easily separated forms, slightly attached, but capable, for some time at least, of an independent existence. These two Medusa forms; one (anterior natatory body) including the other (posterior natatory body), may be very similar, as in Diphyes, or very dissimilar, as in Cuboides vitreus. In the latter, the including (anterior) individual is large and cuboid, the included (posterior) individual is small, tetragonal, and campanulate; whereas in Abyla trigona, the reverse occurs, the including individual being here small, subcuboid, and campanulate; and the included, much larger, oblong, and polygonal.*

Agassiz goes on to argue from all this, as follows—"But notwithstanding the polymorphism among the individuals of one and the same community, genetically connected together, each successive generation reproduces the same kinds of heterogeneous individuals, and *nothing but* individuals linked together in the same way. Surely we have here a much greater diversity of individuals, born one from the other, than is exhibited by the most diversified breeds of our domesticated animals; and yet all these heterogeneous individuals remain true to their species, in one case as in the other, and do not afford the slightest evidence of a transmutation of species."

It is immediately after this that the passage follows, the objection to which has given rise to these remarks—"Would," says Agassiz, "the supporters of the fanciful theories, lately propounded, only extend their studies a little beyond the range of domesticated animals—would they investigate the alternate generations of the Acalephs—the extraordinary modes of development of the Helminth—the reproduction of the Salpæ, &c.,—they would soon learn that there are in the world far more astonishing phenomena, strictly circumscribed between the natural limits of unvarying species, than the slight differences produced by the intervention of man among domesticated animals, and, perhaps, cease to be so confident as they seem to be, that these differences are trustworthy indications of the variability of species."

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* In Prof. Huxley's elaborate Monograph of the Oceanic Hydrozoa (Ray Society, 1859) the Cirrhigrada and Physograda of De Blainville are recast and differently arranged, forming the two families, Calycophoridæ and Physophoridæ. The including and included individuals spoken of in the text are regarded by him as organs of propulsion, and distinguished as proximal and distal nectocalyx. I have retained Cuboides as an illustration, because it does not appear that this is interfered with by Huxley's supposition that it is a Diphyozoöid, derived from Abyla. In Hippopodius, a genus of the Calycophoridæ, the nectocalyces are said to be as many as twelve in number.

I have here fairly stated Agassiz' views—in fact quoted them nearly verbatim, simply adding illustrations; and, I need scarcely remark, in the first place, that these "astonishing phenomena" can, in no respect, be imagined to be *novelties* to M. Agassiz, who, thirteen years ago, published, in conjunction with A. A. Gould, the admirable "Outlines of Comparative Physiology," in which a chapter is devoted to a lucid exposition of these very changes. In the second place, that in Darwin's work on the "Origin of Species," the subject of the "alternate generations of Acalephs, the extraordinary modes of development of the Helminth, and the reproduction of the Salpæ," are altogether ignored, and find no place in the argument, being nowhere, in the remotest manner, alluded to. From this I deduce *three* things:—First, that no man had more cause than Agassiz, by reason of his thorough acquaintance with the subject in all its bearings, to be impressed with the vast importance of these polymorphisms and alternations in any question of biology so comprehensive as the Origin of Species. Secondly, I think we have every right to infer that these most curious and astonishing phenomena (notwithstanding the elaborate notice which he takes of the somewhat analogous phenomena of *neuter insects*) had not been regarded by Darwin in so important a light as to make him consider them a necessary part of his argument, or a possible objection to his theory; and, thirdly, that Agassiz, whose opinion on the question must command the highest respect, by calling attention to the omission, has done nothing more nor less than might reasonably have been looked for from so distinguished a Physiologist.

But I still maintain that the object of the whole reasoning of Agassiz in the passage quoted is simply to draw the reader's attention to the fact of the great extent to which polymorphism obtains among Acalephs, and that he nowhere states that he regards the metamorphoses undergone by them in the alternations of generations, in the light of *varieties*. He simply includes, and very properly, the cycle of ovum, hydroid, and medusoid, in *one polymorphic species;* and the illustration is, therefore, perfectly just.

But if Agassiz *had* definitely stated his opinion that the transformations of the Medusæ could be regarded as varieties, his doctrine would not have been so heretical but that he would have received the support of many eminent physiologists, and among them of the late illustrious Professor E. Forbes, than whom few had more closely studied the Acalephæ, as his beautful Monograph, published by the Ray Society, amply testifies. At page 82 of that work, he says—"In what light are we to regard the relationship between the Medusa and Polyp? The one is *not the larva* of the other, as is often improperly said, because there is *no metamorphosis* of the one into the other. The first is the parent of the last, and the last of the first, but neither is a *stage* of an *individual* existence, destined to begin life as a Medusa and end it as a Poloyp, and *vicé versâ.*

In the case of Aurelia—

a. The Medusa produces eggs;
b. The eggs produce Infusoria;
c. The Infusoria fix, and become hydroid Polyps;
d. The hydroid Polyps produce Medusæ by gemmation.

With such facts, unquestioned facts, before us, it seems to me that we have no choice between theories, and we must admit the idea of *alternation of generations* to be true."

In point of fact, however, the phenomena of alternate generations, or "the production of dissimilar individuals among sexual animals, by a non-sexual process" (Allen Thomson) are far more astonishing than the transformations undergone by insects. For there is only the most superficial analogy between the *alternation of generations* of Medusæ and Salpæ, and the *metamorphoses* of insects. In the latter there is a distinct change from one stage into another, readily traceable; in the former, the animals "remain different through their whole life, so that their relationship does not appear until a succeeding generation. The son does not resemble the father, but the grandfather; and in some cases the resemblance reappears only at the fourth or fifth generation (as in Distoma) or even later" (as in Aphis, at the ninth.) Thus in the case of the Acalephs—the little animal, which on leaving the egg, has the form of an infusory, passes in succession through the phases of Scyphistoma, Strobila and Ephyræ, so called, because, before these changes were understood, they were imagined to be different *genera*, and were named accordingly. "But the remarkable point in these metamorphoses is, that what was at first a single individual, is thus transformed by transverse division into a number of entirely distinct animals, which is not the case in ordinary metamorphoses. Moreover the upper segment [of the strobila] does not follow the others in their development. Its office seems to be accomplished as soon as the other segments begin to be independent; being intended merely to favour their development, by securing and preparing the substances necessary to their growth." Hence they are called Medusa polypiform *nurses*. "There is [then] this essential difference between the metamorphoses of the caterpillar, and alternate reproduction, that, in the former case, the same individual passes through all the phases of development; whereas, in the latter, the individual disappears, and makes way for another, which carries out what its predecessors had begun. It would give a correct idea of this difference to suppose that the tadpole, instead of being itself transformed into a frog, should die, having first brought forth young frogs; or that the chrysalis should, in the same way, produce young butterflies. In either case the young would still belong to the same species, but the cycle of development, instead of being accomplished in a single individual, would involve two or more acts of generation."*

I must, however, bring the subject to a close; not for want of material, for it is almost inexhaustible, but because I have already exceeded the limits I had anticipated. I trust I have fulfilled my pledge of justifying the criticism of M. Agassiz from the charges which have been brought against it; and I believe I may safely leave the matter in the hands of those who have listened to my vindication.

At the conclusion of the paper, the PRESIDENT said he would not invite discussion at that late hour (10.5). He desired to express the great interest and pleasure which he was sure had been felt by all who had listened to the many instructive matters which had been brought before them in the paper which had just been read by Dr. Collingwood, who, nevertheless, he thought, had altogether failed in showing the injustice of his strictures on the criticism of M. Agassiz. He would confine his remarks to two points, and, after all that had been said, he considered the illustration of the embryo snake and the embryo bird was an appeal to ignorance and not to science; and that M. Agassiz' petulant and offensive assumption of want of information on the part of Mr. Darwin and his supporters, on a subject unquestionably familiar to them, justified his censure of M. Agassiz' review as unworthy of so distinguished a philosopher. He (the Rev. H. H. Higgins) was not a supporter of Mr. Darwin's theory, but he deeply regretted the uncandid manner in which it had been in many quarters attacked.

Dr. COLLINGWOOD observed that calling the similarities among embryos "an appeal to ignorance" was simply begging the question. He did not consider it necessary to repeat his arguments, but he would cheerfully abide by what he had written, and was quite content that it should stand as the record of his defence of Agassiz.

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* The passages in inverted commas I have quoted from Dr. Wright's edition of Agassiz and Gould's "Outlines of Comparative Physiology," London, 1851. I have considered myself justified in doing this, for these reasons; first, because although a work of Agassiz himself, two other names are associated with his in it;—secondly, because the statements are the most succinct and definite I have been able to meet with;—and thirdly, because I believe they are still accepted as the correct and philosophical view of the subject of *alternation of generations.*

Dr. **Edwards** hoped the President would not leave the chair without affording him the opportunity of expressing the gratification he had received from Dr. Collingwood's able exposition of M. Agassiz' views, and he moved that the cordial thanks of the society be presented to him; for he felt sure that all present must have been pleased with the philosophical tone and highly instructive character of his paper, which, he considered, relieved M. Agassiz from the charge of wilful obscurity, and, at the same time, was exceedingly impartial on the general subject.

The Rev. C. H. **Burton** seconded the motion, and confessed that he could not agree with the President's remarks, for he considered that Dr. Collingwood had successfully justified M. Agassiz.

SIXTH ORDINARY MEETING.

Royal Institution, 7th January, 1861.

The Rev. H. H. HIGGINS, M.A., **President**, in the Chair.

Mr. **David Anderson**, of Egremont, was elected a member of the Society.

The **President** called attention to the magnificent illustrated works recently presented to the Royal Institution by the Emperor of the French, and the late King of Prussia, and which, having been handsomely bound, are now placed in the Library. Among the various works presented by the Emperor of the French was the beautiful one on the Catacombs of Rome; and the work of Lepsius on Egypt, from the late King of Prussia, was a very valuable addition. The town of Liverpool was indebted to Mr. T. C. Archer for these splendid donations.

The **President** also referred to Dr. Wallich's recently published "Notes on the Presence of Animal Life at Vast

Depths in the Sea," in which it is stated that in sounding not quite midway between Capes Farewell and Rockall, in 1,260 fathoms, a number of starfishes, belonging to the genus *Ophiocoma*, came up adherent to the lowest fifty fathoms of the deep sea line employed. Such facts as these were extremely interesting, because they are quite at variance with our existing ideas respecting the depth at which animal life can exist in the sea.

Mr. RICHARD BROOKE, F.S.A., then read a paper on—

"THE PROGRESS OF ART, SCIENCE, AND USEFUL INVENTIONS, SINCE THE MIDDLE AGES,"

in which he showed by an elaborate reference to the history of inventions, that most of our important and wonderful discoveries are of comparatively recent date.

SEVENTH ORDINARY MEETING.

ROYAL INSTITUTION, 21st January, 1861.

The Rev. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The Rev. J. MACNAUGHT, M.A., and Mr. H. B. ROBERTS, were elected members of the Society.

Dr. COLLINGWOOD drew the attention of the meeting to the Reports of the Microscopical Section of the Literary and Philosophical Society of Manchester, in which it was stated that envelopes had been supplied by the society for distribution among captains of vessels to enable them to preserve soundings, and other similar materials, for microscopic examination; and, he further added, that directions for the preservation of minute objects of natural history had been lately drawn up by Mr. William Weightman, with the object of calling the attention of captains to their collection under favourable circumstances.

The **President** referred to a lately published work by Professor Phillips, entitled "Life on the Earth, its Origin and Succession," which he strongly recommended to the notice of the members of the Society; and read a passage from it, which placed the difficulties of the developmental hypothesis in a very just and strong light.

Dr. **Collingwood** exhibited and remarked upon the valuable work just published by the Ray Society, on British Spiders, by Mr. John Blackwall. This work is copiously illustrated with beautifully coloured plates, and is the first of two volumes upon this hitherto neglected subject.

The Rev. J. **Robberds** drew attention to a published paper by Mr. P. H. Holland, read before the Society of Arts, on the means of preventing coal-pit accidents, in which the writer urged the desirableness of compelling colliery-proprietors, by Act of Parliament, to insure the life of every miner employed, so as both to secure some provision for his family in case of accident, and also to make it the interest of the proprietors to enforce every known precaution against accidents, in order to reduce the rate of insurance. The writer calculated that an advance of only one penny per ton on the 66,900,000 tons of coal annually raised, would be sufficient to insure the life of every miner to the amount of £200.

The following paper was then read:—

OBSERVATIONS ON AURORA.

By DAVID WALKER, M.D., F.R.G.S., M.R.I.A., F.L.S.

(Late Surgeon and Naturalist to the "Fox" Arctic Exploring Expedition.)

In bringing before you to-night some remarks as to the appearance, formation, and cause of Aurora, I shall confine myself to that which appears in the northern hemisphere, and is thence designated Aurora Borealis. I feel inclined to suppose that some of my remarks will apply to the Aurora Australis, but do not wish to encumber myself with reference to a phenomenon which I have never witnessed.

An appearance so remarkable as the Aurora could not fail to attract the attention of early observers, and afford cause for much conjecture. About the earliest theory respecting the cause was, that it was produced by the refraction of the Solar rays; another was, that it was identical with the tails of comets; another, that it depended on a mixture of the atmospheres of the earth and sun; while others ascribed it to the effects of the magnetic fluid. But as the science of electricity became better known and more fully developed—when its luminous effects were shown—and especially when a resemblance was traced between the luminosity displayed by the passage of an electric current through a partially exhausted tube, and the appearance of Aurora, all previous hypotheses were set aside, and the theory of Eberhard and Cavendish was adopted. They supposed that Aurora is dependent on electricity, transmitted through regions where our atmosphere is in a very rarified state; at the same time, it was also considered to have some connection with the magnetic forces of our earth. Since the laws of meteorology have become better known, and the practice of recording meteorological observations more widely extended, the appearance of Aurora has attracted more attention, especially in its connection with the local variations of the magnetic needle and the disturbances sometimes noticed in the atmospheric electrometers.

Such observations have proved the fact that the Auroral light has been simultaneously perceived over a very extended space; for instance, Auroras in 1831 and 1839 were noticed at the same time, not only in the northern hemisphere, but also in the southern. Tables of the comparative frequency of the appearance of Auroras in different places point out the arctic zone, however, as that in which these phenomena most frequently occur.

Electricians and astronomers have endeavoured to ascertain the height of the Aurora above the earth, especially by measuring the height of the arc of the Aurora at different places, but as their observations were taken from different points of view, probably, each observer saw his own particular arc, and the results are, therefore, discordant. Thus, of two observers who calculated the height of the Aurora in January, 1831, one made it 18 miles—the other, 96.

The ancients supposed the height of the Aurora to be very great—even beyond our atmosphere—but later observers reduced it to 75 miles; thus, Cavendish supposes its usual elevation to be about 71 miles above the earth, at which elevation the atmosphere must possess but $\frac{1}{150000}$th part of the density of that at the earth's surface. Still more modern observers think it does not rise above the region of the clouds; and Wrangel, Struve, Parry, Fisher, and others, ascribe to it a very inconsiderable height.

Very valuable observations have been made by different persons in Aberdeenshire, tending to prove that, at times, its height is not more than half a mile above the surface of the earth. Parry, in January 7th, 1825, whilst watching the variations in the form of an Aurora, saw a ray of light dart down from it towards the earth, between himself and the land which was about 3,000 yards from him; this was also witnessed by two of the officers of the expedition. I believe I am correct in stating that many of the arctic observers believe the Aurora to attain a very inconsiderable elevation in high latitudes. Hood and Richardson observed the same Aurora from different places: to the one it appeared in the zenith, forming a confused mass of flashes and beams—to the other, at many miles distant, looking in the same direction as the first observer, it presented the aspect of a low illumined arch. Sir William Hooker informs me that while passing a night on the summit of Ben Nevis, he distinctly saw the Aurora hanging in the valley between a neighbouring elevation and that upon which he stood; also that, at another time, during a fall of snow upon a mountain side, he observed that the particles were distinctly luminous, the air giving evidence, at the same time, of the presence of much free electricity. General Sabine also tells me that he has seen the Aurora low down, and passed through it, as one would walk through a mist. On the nights of the 30th and 31st March, 1859, I noticed the Aurora between myself and the land. The patches of light could plainly be seen a few feet above the surface of the water in Bellot Straits, the opposite land being about 2½ or 3 miles distant; and I am confident that if that land had been sufficiently high, the greater number of the 24 Auroras seen during the winter of 1858-9 above the water space in Bellot Straits, if not all, would have been seen suspended at a low elevation above the water or ice. To give as accurate a description as possible of my own experiences of Aurora, I transcribe from my journal, verbatim, the following extracts, to show some of the data upon which my remarks are founded:—

"Nov. 9, 1857 11 p.m. I have just come down from deck, where I saw one of the finest Auroras we have had as yet—it extended for about 90°, being about 7° above the horizon—of a colour changing from a pale yellow to pale green, with vertical streamers towards the zenith; it seemed to appear just above a misty or foggy bank, which gradually enlarged till it obscured the Aurora; there were no vibrations or oscillations, but at times the Aurora was broken up into detached pieces; it was from S. to W., and lasted for an hour and a quarter.

Nov. 23. A pale, yellow Aurora appeared this evening for about an hour in the N.W. horizon, with occasional streamers rising 6° to 7° towards the zenith; it was rather vacillating in its character whilst it was visible; it was situated between Saturn and Jupiter. Another very bright one has just appeared from N.W. to S.E.; it was by far the brightest yet seen, and of a pale green colour; it appeared generally in arcs about 10° above the horizon; these arcs seemed to be composed of centres of effulgence with light spreading from the sides, and streamers stretching 20° towards the zenith; at other times broken up into detached pieces like the glow discharge of the electrical machine, sometimes divided into three tiers of arcs, all having streamers.

Wednes. Dec. 16th. Going upon deck at 9 p.m., noticed a hazy luminosity all over the sky; about 9.15 the Aurora presented itself; it commenced in the S., and then passed in a horizontal band to E., from that it passed to N. and N.N.W.; *south* joining *north* by a band through the zenith; E. also joining N.N.W. by a similar band. Three or four times I noticed a distinct pulse passing from S.E. to E., and from E. to N.; at times the merry dancers appeared, but at no time was there a brilliant appearance, only a universal luminosity; bands and conglomerate masses prevailed, but a few arcs appeared towards and round the zenith; there was a little wind and the pulsations seemed to go contrary to it. The stars which were studding the sky were perceptibly dimmed—*no* sounds were heard—the colour was from a very pale yellowish green to a pale pink; it remained apparent for abou 15 minutes, *after which the atmosphere was filled gradually by a mist;* the luminosity formed no definite shape, except the few arcs spoken of; they only had pink; temp.—14°, bar. 29° 80.

Thurs., Dec. 17th, at 6.30 p.m., observed a faint Aurora from S.S.E. to E.; nothing particular about it; died out about 7.15. At 10 p.m., observed a bright Aurora, extending from S. to N.N.E.; a low bank of fog, 5° above the horizon, formed the edge of an arc, about 1° broad; 2° above this, another arc was situated, about 4° broad; these changed into broad luminous clouds at times, and then, again, formed a thin, long, arc, extending continuously from S. to N.N.E., with streamers ascending 8° to 10° towards the zenith; the colour generally a yellowish green, but once it was quite reddish in the E.; at this point, the Aurora was most intense and constant. I again noticed the pulse wave; it oscillated from S.S.E. to E.; the "merry dancers" sometimes was the form assumed; once or twice there was an instantaneous intensity in the light of the whole mass, and as quick a relapse to the original. In the thick body of the Aurora the light was so intense as completely to hide the appearance of stars of the first magnitude—through the streamers the stars showing, although but dimly; it is still visible; (12 p.m.) since its appearance the wind has increased; temp.—21°. At 11 o'clock, I noticed a falling star of a very bright character; it descended from 35° above the horizon and below Saturn, towards the horizon, but, on approaching the Aurora, it was dimmed, and then completely obscured; when it came to the thick band it left a tail 2° behind it—it fell very slowly. No sounds were heard with the Aurora; those bands which did appear were as luminous as those of last night, but were more confined to one part of the sky.

(12 p.m.) Still continues, more concentrated, and a little brighter; dense streamers, longer and altogether higher above the horizon. (4 a.m.) The Aurora still brilliant, and in the same direction, but forming more of an arciform shape, and changing sometimes to a reddish hue. (9 a.m.) Still apparent, —now crosses the zenith—not in streamers, but more in shapeless patches of thin light, across the zenith from S.W. to W. and W.S.W.; also, from E. to N.W., a broad band about 70° above the horizon in E., very persistent against the blue black ground; the stars are visible through it. *Minute spicula of snow visible through the atmosphere.*

Friday, 18th. As the daylight increased, the Aurora became less visible, and at 10 a.m., it was not seen, but, in its place, thin, fleecy clouds appeared, just as if it had been the cloud which had been rendered luminous. Everything having been prepared, at 10.30 a.m., whilst the cloud still remained, I connected an electrometer with the copper chain in the observatory, when distinct separation of the gold leaves took place. At 6 p.m., an Aurora was visible from E. to W. and N.W. across the zenith; it was in the form of bands or streamers. I again tried the electrometer, and again perceived distinct divergence of the gold leaves; this Aurora disappeared about 7 p.m. Again, at 8.30, there was an Aurora, stretching from S.S.W. to S.S.E., in the form of a bent arch or horseshoe, the key being in the S.S.E. Again, the electrometer was connected, and a still greater divergence of the gold leaves than before was noticed; this might be accounted for by the greater luminosity of the Aurora. I tried paper, saturated with iodide of potassium, interposed between two platinum wires, connected with the chain and the water, but no decomposition took place, and no spot was obtained. (12 p.m.) This Aurora is still visible, but with no particular shape; it extends from S.S.W. by S. to N., and not only horizontally, but towards the zenith, scintillations appear; it is most luminous towards the

S., where, occasionally, a wave appears, not like a pulse, as was the case the last two nights, but as if the cloudy appearance had been connected in the S.S.E. with an electric machine which when turned caused a flash of light to proceed from S.S.E. to S. Thin streamers passing towards the zenith; the body of the light decidedly obscures the stars of all magnitudes behind it; temp.—23° 5′, bar. 29° 82.

March 2nd, 1858. At 10.30 p.m. Patches, arches, and streamers of Aurora from S.W. by S. to E. from the horizon to the zenith, at times very bright, and with an occasional appearance, as if it were driven by a wind from S.W. by S. to S.E.; not wave-like, nor pulse-like, but just as the wind would drive a column of smoke, still keeping its defined outline. It was not of a dense character, as the stars were but little dimmed.

Dec. 24th, 11 p.m. Strong, flashing Aurora all over the heavens, causing great disturbance of the magnetometer. (12 p.m.) There is now no Aurora, and the magnetometer is steady. At the height of the Aurora the magnet oscillated at least 15°, so that I had to take the mean.

Jan. 10th, 1859, 12 p.m. A fine night, with Aurora since 8 p.m., from N. to S., across the zenith, in strong bands, at times varying their position. Used the electrometer at 10 p.m. found it affected; at 11 p.m. the magnetometer was slightly oscillating.

Jan. 31st. Aurora this evening from 6 to 8—from S.E. to W.,—bands from near the horizon to the zenith—a most distinct divergence of the leaves of the electrometer showing the influence of the Aurora.

Feb. 19th. Aurora at 11 p.m.,—from S. to N.,—through zenith—magnetometer unsteady.

Feb. 26th, 11 to 12 p.m. Aurora from N. to S.,—through the zenith—affecting (somewhat) the magnetometer."

To sum up: More than half the number of the Auroras noticed during the two winters of 1857-8, and 1858-9, were seen in the direction of an open water space where much evaporation was going on; these Auroras beginning to appear at various degrees above the horizon, over a fog bank. It will be noticed that some of them affected the electrometer and the magnetic needle, causing, in the former, marked and increased divergence of the gold leaves; and, in the latter, considerable oscillation and variation in its movements.

I now proceed to quote some of the more recent and generally accepted theories, and explain that which first suggested itself to me when in the arctic regions, and which subsequent observations have confirmed. I approach this point with diffidence, as my theory clashes with those of some of the most scientific men of the day; at the same time, having observed data to work upon, I cannot but attach some weight to the results of personal and careful study.

M. Biot's theory is, in substance, as follows:—That the luminous clouds of which the Aurora consists are composed of metallic particles, reduced to an extremely minute and subtle form. Such metallic clouds (if the expression may be permitted) will be conductors of electricity, more or less perfect, according to the greater or less proximity of their constituent particles. When such clouds arrange themselves in columnar forms, and connect strata of the atmosphere at different elevations, if such strata be unequally charged with electricity, the electrical equilibrium will be re-established through the intervention of the metallic columns, and light and sound will be evolved in proportion to the imperfect conductibility of the metallic clouds, arising from the extremely rarified state of the fine dust or vapour of which they are constituted. If the metallic cloud possess the conducting power in a high degree the electric current may pass through it without the evolution of light or sound; and thus the magnetic needle may be affected as it would be by an Aurora, though none be visible. If any cause alter the conductibility of those columnar clouds, suddenly or gradually, a sudden or gradual change would follow in the splendour of the Aurora.

M. Becquerel objects to this theory, that the existence of metal in that uncombined form—in which alone it has the conducting power—in volcanic eruptions, is not yet proved.

It should be said that M. Biot supposed the electricity to proceed from polar volcanoes.

Professor Faraday, in vol. 1 of his "Researches," remarks —"I hardly dare venture, even in the most hypothetical form, to ask whether the Aurora Borealis and Australis may not be the discharge of electricity thus urged towards the poles of the earth, from whence it is endeavouring to return by natural and appointed means above the earth to the equatorial regions."

Humboldt says—"The Aurora Borealis has not been described merely as an external cause of a disturbance in the equilibrium of the distribution of terrestrial magnetism, but rather as an increased manifestation of telluric activity, amounting even to a luminous phenomenon, exhibited on the one hand by the restless oscillation of the needle, and on the other, by the polar luminosity of the heavens. The polar light appears, in accordance with this view, to be a kind of silent discharge or shock, at the termination of a magnetic storm, very much in the same manner as in the electric shock, the disturbed equilibrium of the electricity is renewed by a development of light by lightning, accompanied by pealing thunder."

M. de la Rive, after speaking of the two electricities of the earth and atmosphere, and the recomposition going on between them, and stating that the great electrical discharge takes place at the poles, proceeds—"This discharge, when it has a certain degree of intensity, will be luminous, especially if—as is nearly always the case near the poles, and in the higher regions of the atmosphere—it meet on its way those extremely attenuated frozen particles out of which the loftier clouds and mists are formed."

The following remarks embody my ideas on this subject:—

In the arctic seas there is always more or less evaporation from the surface of the exposed water, and, according to the time of year, the area of exposed sea surface will be great or small. Towards the end of August and beginning of September, as the sun's altitude decreases, the nights become gradually colder, the surface of the sea is frozen over, and the difference between the temperature of the air and the water increases. [For my purpose I shall speak of the sea of Baffin's Bay and Davis' Strait.] As the season advances, the evaporation which in summer appears as fog and mist, in winter takes the form of what is called "frost smoke"—that is—wherever a space of water appears, and the temperature of the air is colder than the water, the vapour of the water, in rising from its surface, becomes visible as a dense mist over that place, and is termed "frost smoke," or "water blink." At the south of Greenland, where the ice of Davis' Strait edges upon the waters of the Atlantic, a greater number of Auroras is seen than in any other place along that coast line. The mass of ice filling up Davis' Strait and Baffin's Bay is broken up by winds, tides, and currents, and spaces of water appear among the fields of ice; these spaces are recognised through the winter by the "frost smoke" rising from them. The air in the neighbourhood of these seas, is always loaded with extremely minute spicula of snow. Many of the Auroras noticed were in the direction of the open spaces of water seen during the day, such spaces being, as usual, marked by the "frost smoke." I believe these Auroras were connected with the vapour arising from the open spaces of water, and that they were caused by the condensation and subsequent freezing of the particles of vapour; such particles evolving positive electricity, and by induction from the surrounding atmosphere, producing a light, transmitted from particle to particle, thus rendering the whole mass of vapour luminous, the lower edges of the arch of the Aurora being the place where this condensation and congelation first takes place. As the cold increases, the number and intensity of Auroras, seen at any place on the Greenland coast, are proportionate to the proximity of the edge of the ice to that place.

Early in the winter, at the northern ports of Greenland, the Aurora is seen indefinitely—higher up in the sky, and nearer the zenith, than at a later period of the year—when, after the sea has been, to a great extent, covered over with ice, the Aurora locates itself towards the open water spaces. In reading Dr. Kane's account of his last expedition, I was struck with the fact that Auroras were scarcely ever seen during his stay at Rensselaer harbour, the first having been noticed some 15 months after his arrival there. I account for this by the absence of open water in his neighbourhood, and to me it is an additional proof of the non-existence of a *polar basin.* As a rule, Auroras increase in brilliancy as they approach the zone of the line of winter ice.

During the homeward voyage of the "Fox," across the Atlantic, in September, 1859, I had the opportunity of seeing several Auroras, which at times assumed the appearance of cirrhous clouds; at other times they presented the usual luminous Auroral aspect; many times since I have noticed the same appearance. I am of opinion that the Auroras seen in our latitudes, and across the zenith in the arctic regions, are produced by the same cause as those just described near the horizon.

Whenever the temperature of a cloud, charged with particles of vapour, is lowered—either by changing its position, or by the access of a colder atmosphere—and the particles become frozen—evolving positive electricity, and, by induction, causing a luminosity; such clouds, meeting with others charged with opposite electricity, would communicate by means of streamers, these also being luminous. These appearances will present themselves wherever there are clouds composed of frozen particles, acted upon by the surrounding atmosphere, or by neighbouring clouds, so that *no* altitude will be too great, or too inconsiderable for the appearance of Aurora, so long as the atmosphere contains the necessary conditions for the evolution of this light. It will thus appear that the wind may cause a pulsation in the body of an Aurora, and even an increase in its brilliancy, the friction produced by it, perhaps causing an increase in the electricity.

In other words, a vapourous cloud, passing through a region where the air is of lower temperature, becomes condensed, and (if the temperature be sufficiently low) composed of minute frozen spicula, which induce recomposition between the negative clouds near them, causing streamers and bands to flash out light. I have often noticed in these streamers an appearance, as if the light were *sucked* up towards the zenith. I believe Aurora is never seen, except when these clouds, or other similar vapours, are exposed to the process of congelation.

The appearance of Auroras in the direction of, and over the places where open water spaces exist, and the connexion between cirrous clouds and Auroras, to me appear positive proofs of the truth of this "congelation" theory.

The two Auroras seen in Bellot Strait, between myself and the land, were apparently but a few feet above the surface of the water. The lower part of the vapour was comparatively transparent; above this was a fringed darker portion, then the auroral lights pervaded the remainder, not as a flash, which might have been an optical illusion, but steadily waving between my position and the land.

I shall now enumerate a few facts which seem to me to bear upon the subject. Dr. Richardson, near Bear Lake, saw the palpitations of the Aurora before the total disappearance of day-light: during the day he had seen the clouds arranged in arches and columns like the light of the Aurora. M. Lottin, in his description of the general appearance of the Aurora in the Bay of Alten, remarks "that after the first half of the night the Aurora seems to have lost its intensity, the pencils of rays, the bands and the fragments of bows appear and disappear at intervals; the rays become more and more diffused, and ultimately merge into the vague and feeble light which is spread over the heavens, grouped like little clouds and designated by the name of *auroral plates*. The phenomena became gradually more faint and disappeared altogether on the appearance of twilight; it often happens that as the daylight augments, the Aurora gradually becomes vague and undefined, takes a whitish colour, and is ultimately so mingled with the cirro-stratus clouds that it is impossible to distinguish it from them." Humboldt remarks, "The knowledge which we at present possess of the altitude of the polar light is based on measurements which from their nature, the constant oscillation of the phenomenon of light and the consequent uncertainty of the angle of parallax, are not deserving of much confidence. The results obtained, setting aside the older data, fluctuate between several miles and an elevation of 3000 or 4000 feet: and in all probability the northern lights at different times occur at different elevations. The most recent observers are disposed to place the phenomenon in the region of the clouds and not on the confines of the atmosphere: and they even believe that the rays of the Aurora may be affected by winds and currents of air, if the phenomenon of light (by which alone the existence of an electro-magnetic current is appreciable) be actually connected with material groups of vesicles of vapour in motion, or more correctly speaking if light penetrate them, passing from one vesicle to another." Almost all observers, in speaking of the origin of an Aurora, remark that it rises above a fog-bank; I shall transcribe the words of M. Lottin—"Between the hours of four and eight o'clock in the afternoon a light sea fog, which almost constantly prevailed, extending to the altitude of 4° or 6° above the horizon, became coloured on its upper border, this border becomes gradually more regular and took the form of an arc of a pale yellow colour, &c." Gissler in his observations taken in Sweden states—"that on the high mountains the traveller is sometimes suddenly enveloped in a very transparent fog of a whitish grey colour passing slightly to green, which rises from the ground and is transformed into the Aurora Borealis." Humboldt again remarks "that the greatest absolute number of northern lights appears to occur towards the close of the months of September and March." Herr Rink in his remarks upon the Auroras of Greenland, states "that undoubtedly the Aurora is seen more frequently and in a more intense degree in South Greenland than in North Greenland, and he can decidedly affirm that the Auroras at Julianehaab, 61° N. lat., were seen from three to four times longer than at Omenak, 71° N. lat., in North Greenland; almost every night in the winter Auroras were seen at Julianehaab." I have spoken of the two maximum periods of September and March, it will now appear evident why these should exhibit more auroral displays than any of the other winter months, on account of the conditions for the formation of such Auroras being more favourable, the open water spaces gradually increasing in extent, and the consequent greater amount of material for the formation of fog bank and cirrous clouds becoming eliminated. The non-appearance of lightning in the arctic regions is accounted for by the electricity being equilibrized by the congelation of the vapour.

I should much like to enter into the connection between the Aurora and magnetism; also its relation to the "électricité dissimulée." Time, however, forbids more than a passing reference to the Auroral bands of Lottin, Humboldt, and others, which I conceive to have been simply cirrous clouds possessing electricity, and arranging themselves according to the laws of terrestial magnetism. The great difficulty of detecting the presence of atmospheric electricity in the northern regions has caused much enquiry; but we may see that the uncombined electricity will be proportionate to the paucity of Auroras; when its appearance is frequent, electric disturbances will be oftener shewn by the instruments. I have previously alluded to the effect of Aurora, not only on the gold leaf electrometer, but also on the magnetometer, which at one time vibrated 7½° either way. This explanation would go far to account for the more frequent appearance of Aurora in this country, the amount of cold having been greater during late winters.

It would be interesting to discuss the connection between magnetism and cold; we know that the poles of each are placed, if not together, at least near each other. But again, time prevents my indulging myself, especially as I know that another paper on a subject no less interesting to the majority of my listeners than the present is to follow mine. In conversing lately with the Rev. Mr. Fisher, the Astronomer of Parry's Expedition, I find that he agrees with all the remarks I now make.

At the conclusion of the paper, the President having invited remarks and questions,

Mr. Towson observed that, while the general phenomena of aurora seemed sufficiently accounted for by Dr. Walker's theory, one phase of it was not fully explained, namely, the sudden springing up of the auroral light from the horizon to the zenith, and its rapid attraction to the horizon. Could it be possible that icy particles could be so instantaneously formed?

Dr. Edwards remarked that his experimental illustrations showed that the nature of the discharge differed according to the degree of condensation of the atmosphere. The nature of the discharge in the higher regions of the atmosphere must, therefore, depend on the altitude. He could not conceive that icy particles should exist in such quantities at so great an elevation above the earth as that at which the auroral discharge took place. He had been led, from experiment, to believe that the auroral discharge was always associated with great tenuity of atmosphere, the best imitations of the phenomena occurring when the gaseous atmosphere would support from one-eighth to one-sixteenth of an inch of the mercurial column. He believed, therefore, that the appearance described by Dr. Walker, of the auroral light descending to the surface of the earth, was an optical illusion, of the nature of a mirage.

Dr. Collingwood thought that inasmuch as Dr. Edwards' experiments were for the most part made in artificial atmospheres, differing very materially from the aerial atmosphere, no positive conclusion could be drawn from what might be an accidental resemblance to the phenomena of aurora; or, at all events, no argument could be supported by those experiments against carefully observed facts, such as Dr. Walker had described.

Dr. Edwards explained that the Torricellian vacuum gave as good a result as any artificial atmosphere.

Mr. Robberds remarked that Dalton had called attention to the fact that aurora was usually unaccompanied by clouds, being, in fact above the region of clouds.

Mr. Higginson said it should always be recollected that a constant evaporation was taking place from ice.

The President believed that aurora was generally associated with clouds, which obstinately appeared to conceal the most brilliant parts. He thought it probable that the same observation would not suffice to explain all the phenomena, and inquired whether Dr. Walker had ever heard any sounds connected with the aurora?

Dr. Walker replied that there was no doubt that the sounds alluded to were caused by some movements in the different strata of ice, dependent upon their unequal contraction and expansion, and Humboldt had remarked that those only heard such sounds who listened for

them. He also dwelt upon the fact of the auroral light having been seen by himself and others, for some time, hanging between two points of land. In answer to a question from Dr. Collingwood, he stated that the dark bands were certainly not the result of mere contrast with the brighter parts.'

EIGHTH ORDINARY MEETING.

Royal Institution, 21st January, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The Rev. H. J. Hindley, M.A., and the Rev. C. D. Ginsburg, were elected members of the Society.

Mr. Fabert exhibited a remarkably fine specimen of red coral (*Tubipora musica*) from the Chinese seas, and several other objects of interest.

The Rev. J. Robberds drew attention to Mr. P. H. Holland's method of sealing safety-lamps, so that they could not be opened without detection. The plan was similar to that of the metallic fastenings formerly applied to envelopes.

Dr. Collingwood exhibited some of the microscopic collecting envelopes referred to at the last meeting.

The President drew attention to the contemplated anniversary festival of the Liverpool Naturalists' Field Club, to be held in St. George's Hall, in April next, and read a prospectus of the proposed plan. He invited the assistance of ladies and gentlemen interested in the subject.

The following paper was then read:—

CONTRIBUTIONS TO NAUTICAL SCIENCE.

By THOMAS DOBSON, B.A.,Cantab.

(Head Master of the School-frigate "Conway.")

When Newton was engaged in investigating the nature of the great mechanical laws that govern the material universe, he is said to have made use chiefly of the method of fluxions, the most efficient instrument of mathematical investigation known at that time; but he took care to clothe the results of his researches in a comparatively simple geometrical dress.

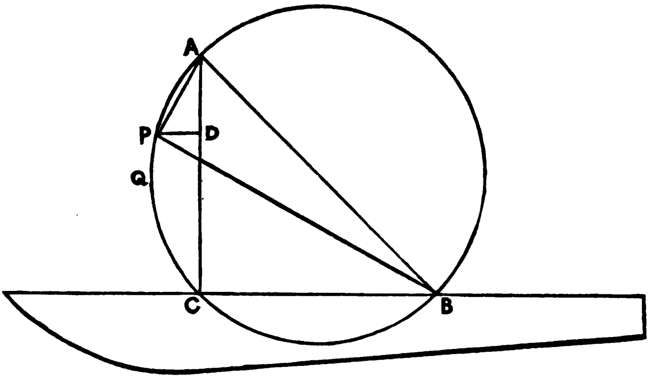
The wisdom of such a course will be appreciated by persons engaged in instruction, who have to communicate to others the knowledge of necessary truths at which the philosopher has already arrived only by a patient and skilful marshalling of his mathematical symbols; and this communication is only practicable with young students when the subject can be presented to them in an elementary form. The mathematician of our day employs in discovery the Differential and Integral Calculus, justly styled by Dr. Whewell, in his Philosophy of the Inductive Sciences, "the principal weapon by which the splendid triumphs of modern mathematics have been achieved." But the philosopher seldom condescends now to imitate the master of philosophy by announcing his discoveries to the world in such a simple form as to put them on a level with the capacity and attainments of all who may have an interest in understanding them. His is the noble ambition of discovering hidden truth, and he leaves to others the humble, but still useful and honourable, office of devising the best means of diffusing a knowledge of his discoveries. My daily avocations have led me to become a labourer in this humble sphere.

Of all men, the sailor is most indebted to the mathematician, who has framed the rules which the sailor practices and relies upon; and computed the numerical data which the sailor takes from his Nautical Almanac; data which embody the practical results of mathematical problems of the very highest order of difficulty, and which have taxed the powers of the greatest mathematicians from Newton's time to our own.

Nautical science, then, having thus been constructed by help of the higher mathematics, offers an ample field for simplification; and that such a process is most desirable will be obvious when we reflect how essential a clear knowledge both of the principles and practice of nautical science is to that numerous and valuable body of men who are responsible for all the lives and property afloat. Such knowledge is more than ever indispensable in these days of steamships, clippers, and rapid passages, when a merchant captain must strain every nerve—and what is much worse, run every risk—in order to satisfy an exacting public, by making a passage in the shortest possible time. It is evident that the danger from an error in the reckoning of a dull sailing vessel is much less than in that of a long, sharp clipper; on the principle that the further you go on the wrong road, the more you go wrong.

The first subject to which I shall ask your attention this evening is a question relating to practical navigation, and may be enunciated thus:—

"The direction of the wind, and the course of the ship, being known, required the direction of the sails, so that the ship may make the most headway." This problem belongs to the difficult class of "maxima and minima," which are most successfully attacked by means of the Differential Calculus, and thus I first accomplished its solution. But, anxious to bring it within the reach of my pupils, I reconsidered it, and first succeeded in solving it by means of plane trigonometry; but at last was rewarded by discovering the simple geometrical proof which follows. I am not aware that this problem has been published in any form; it is certainly not mentioned in any of the numerous English and foreign works on navigation that I have consulted.



Let A B be the direction of the wind, B C the direction in which the ship is progressing, and B P the projection of a sail on the plane of the deck. Draw A P perpendicular to B P, A C perpendicular to B C, and P D perpendicular to A C. Then, if A B represent the force of the wind, A P will be the effective part of it, acting perpendicular to the sail, and P B the non-effective part, acting parallel to the sail.

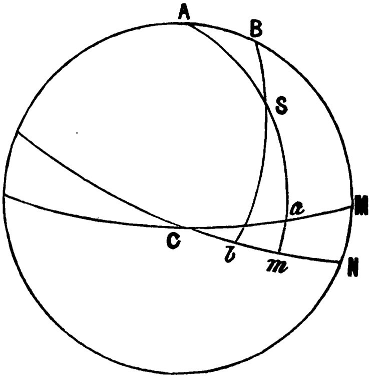
Now, A P is equivalent in magnitude and direction to the two component forces A D and D P, of which A D perpendicular to B C produces leeway only; and D P parallel to B C produces headway only.

Since A P B and A C B are right angles, the points P and C lie in the circumference of a circle of which A B is the diameter; and P D is the perpendicular from a point in the arc A C on its chord A D C; and will obviously be greatest when P coincides with Q, the middle point of the arc A C. Hence, in order to make the most headway, the ship's sails and yards should, as nearly as the shrouds, &c., will allow, lie midway between the ship's course and the direction of the wind.

In some of the most important practical applications of nautical astronomy, where two altitudes of a heavenly body are taken at an interval of a few hours, during which the vessel has been proceeding on her course, it is necessary to reduce the first altitude to what it would have been if it had been measured at the place where the ship is when the second observation is made.

My second contribution to nautical science is a simple elementary investigation of the value of the correction to be applied to the first altitude to compensate for the "run" of the ship, as it is called. This value, of course, is well known, but my proof is well adapted for instruction, inasmuch as it has the advantage of placing clearly before the student the things which he is required to reason about, and is made to depend upon the rule for parallel sailing—the simplest case in spherical trigonometry. In this case, as in several others, I had the alternative of either inventing a simple intelligible proof, or of giving the rule to my pupils without demonstration, and resting on authority alone, a mode of proceeding altogether inconsistent with sound teaching.

Let S be the sun's position when the ship's zenith is A; S*a* the sun's altitude above the horizon C M of A; S*b* his altitude above the horizon C N of B; where B is the zenith of the ship at the time of the second observation.



Let A B = d = M N, the distance run between the two observations;

$$Sa = a; \text{ and } \angle S A B = A.$$

Since Sm is sensibly equal to Sb, the correction to be added to Sa in order to make it equal to Sb is $a\,m$. Now $\angle$ C is small, and Ca = Cm very nearly, therefore $a\,m$ will not differ sensibly from the arc of a small circle of the sphere described with centre C, and passing through a and m.

$$\text{Hence, } a\,m = \text{M N cos. } a\text{M} = \text{d cos. A}.$$

$$\therefore \quad Sb = a + \text{d cos. A}.$$

If $\angle$ A is greater than a right angle, the figure will give

$$Sb = a - \text{d cos. A}.$$

The following paper was also read:—

NOTES AND EMENDATIONS TO SHAKSPERE'S "MERCHANT OF VENICE."

By WM. IHNE, Ph.D., *V.P.*

I.

I., i., 29, 4.*

> "To find the other forth, and by adventuring both."

Verses of six feet, like this, are indeed frequent enough in Shakspere; but, unless I am much mistaken, some of them owe their origin to the early editors, and not to the poet. The present verse would assume the usual length by throwing out two useless syllables. It would then read—

> "To find the other forth, and venturing both."

II., i., 1, 11—

> "*Morocco.* I would not change this hue,
> Except to steal your *thoughts*, my gentle queen."

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* As the scenes in Shakspere are too long to serve the purposes of easy and expeditious reference, the author has numbered the speeches in each scene, and, in long speeches, even the lines. Thus I., 1, 29, 4, means first act, first scene, twenty-ninth speech, being *Bassanio's*, and beginning, "*In my school days;*" and, of this speech, the fourth line.

The word *thought*, which now we refer exclusively to an operation of the intellectual faculties, is in this passage, and frequently by Shakspere, used as synonymous with "feeling," or "heart." Thus it is clearly employed, II, vi., 11, where *Jessica* expresses a doubt if she is really *Lorenzo's*, and *Lorenzo* replies—

> "Heaven and thy *thoughts* are witness that thou art."

And III., ii., 12—

> "*Portia.* How all the other passions fleet to air,
> As doubtful *thoughts* and rash-embraced despair,
> And shuddering fear, and green-eyed jealousy!"

Here we find "thoughts" classed as a passion, with despair, fear, and jealousy.

III., iv., 5—

> "Fair *thoughts* and happy hours attend on you."

This is *Lorenzo's* wish at parting, and it expresses clearly very much the same that *Jessica* adds—

> "I wish your ladyship all heart's content."

Compare "Julius Cæsar," III., i., 67—

> "With all kind love, good *thoughts* and reverence."

II.

II., ix., 3, 6—

> "If I do fail in fortune of my choice."

I think we have here a misprint, perpetuated through all editions, for

> "If I do fail *of* fortune *in* my choice."

Arragon had just said—"If I fail *of* the right casket." The sense becomes much clearer by the proposed alteration.

III.

III., i., 3—

> "*Salanio.* I would she were as lying a gossip in that as ever knapp'd ginger, *or* made her neighbours believe she wept for the death of a third husband."

The knapping of ginger and the fictitious tears must clearly be taken together as proving the woman in question to be a lying gossip, for, surely, the knapping of ginger alone is not a proof of lying. We must, therefore, read, " as ever knapp'd ginger, *and,* &c." *Salanio* alludes to a widow that made her tears flow by the application of ginger, and then pretended she was weeping tears of sorrow.

IV.

III., ii., 10—

"Tell me where is fancy bred,
Or in the heart, or in the head,
How begot, how nourished?
Reply, reply.

Is it engendered in the eyes,
With gazing fed, and fancy dies
In the cradle, where it lies?
Let us all ring fancy's knell;
I'll begin it: Ding, dong bell."

The meaning of this little poem has been entirely hidden and perverted by Steevens' explanation, which appears to have been accepted by all subsequent editors, by Schlegel, in his admirable translation, and by readers in general. Steevens explains "fancy" to mean "love," and appends a passage from the "Midsummer Night's Dream," where fancy clearly has that meaning—

"Sighs and tears, poor fancy's followers."

Many more passages might be adduced to show that "fancy" is used as a synonym of "love;" but the question is, whether that meaning applies here. When we examine the poem, we find that it is not a love song, but a dirge—

"Let us all ring fancy's knell."

What could be more inappropriate or of worse omen than to sing the death-song of love at the very moment when love is to be triumphant, and about to unite two loving hearts together. We must suppose the musical accompaniment to have been under the direction of *Portia.* But it harmonizes very badly with that lady's good sense that she should be guilty of such a blunder. Besides, is it really true, by all the experience of lovers, or is it a theory held by Shakspere, that "love is engendered in the eyes ?" Surely it is not, but, as *Helena* expresses it in the "Midsummer Night's Dream," I., i., 49—

> "Love looks not with the eyes, but with the mind,
> And therefore is wing'd Cupid painted blind."

We must, therefore, on all grounds, condemn Steevens' explanation; and now arises the question, what is the right one? The poem must harmonize with, and have a bearing upon, the scene into which it is inserted. It is the scene in which *Bassanio* has to choose the right casket. His two predecessors had both failed, being misled by the glitter of the outward show to choose the golden and the silver caskets respectively, though the *Prince of Arragon,* like a "deliberate fool," had wisely remarked, that "the multitude choose by show, not learning more than the *fond* eye doth teach"—II., ix., 5. Now, *Bassanio* might have fallen into a similar error; but maturely reflecting on the fallacy of judging through the "fond" eye alone, and from external appearances, and, warned by the friendly admonition contained in the song, that the eye produces fancy, he comes to the conclusion—

> "So may the outward shows be least themselves,
> The world is still deceived with ornament," &c.

The train of ideas with which he begins is evidently but the continuation of those contained in the poem. And now we cannot have the least difficulty in recognising the true meaning of "fancy." It is a contraction of "phantasy," with which "phantasma" and "phantom" are connected, and derived from the Greek, *φαίνειν*, "to show." It denotes that which is unreal, or only apparently real, a creation of the mind, and it is, therefore, used as opposed to truth and reality. Fancy pictures to itself things different from what they are—a fancy picture has always much of fiction in it; the fancy of men, therefore, leads them astray, it is not directed by judgment, and therefore often, as in our passage, equivalent to "illusion."

V.

III., ii., 14, 12—

> "An unlessoned girl, unschool'd, unpractised,
> Happy in this, she is not yet so old
> But she may learn; happier than this,
> She is not bred so dull, but she can learn;
> Happiest of all *is*, that her gentle spirit
> Commits itself to yours to be directed."

The correctness of this passage, as far as I can ascertain, has never been questioned; and yet, it undoubtedly contains a serious error. The three adjectives, "happy," "happier," "happiest," clearly refer to the substantive "girl," to which they form simple attributes. But this attributive connexion is destroyed by the verb "is" in the fifth line. This verb requires a subject to which it must be referred. If the grammatical laws of the language allowed us to supply the pronoun "she" the difficulty would be at once removed, at least as far as the syntax of the sentence is concerned; though the symmetry and regularity would still suffer. But that pronoun cannot be supplied, and therefore, the sentence, as it stands, is incorrect, and has been reprinted, in every edition of Shakspere, in bold defiance, or in happy ignorance, of good grammar. Let us do tardy justice to the poet, and by removing an ugly misprint, restore the genuine reading.

An unlessoned girl,
Happy in this, &c., happier than this, she is, &c.,
Happiest of all *in*[*] that her gentle spirit
Commits itself to yours to be directed.

VI.

III., ii., 14, 20—

"But now I was the lord
Of this fair mansion, master of my servants,
Queen o'er myself; *and even now, but now*
This house, these servants, and this same myself,
Are yours."

Portia contrasts the immediate past with the present time. To the former period she refers by saying "but now," to the latter in the words "and even now, but now." Here, it is strange that the same expression, "but now," should be used in two senses entirely opposed to each other. That they can be used in this way there is no doubt. The "but" in the first expression would be used as an adverb, equivalent to "only," or "almost;" the "but" in the second would be a conjunction, equivalent to "however." We may say—

"But now the mighty Cæsar was a god;
But now he is a lifeless clod of earth."

It is, however, apparent that the adversative conjunction "but" cannot be employed unless it heads that portion of the sentence to which it belongs. It can in no way be preceded by the conjunction "and." Therefore, the words, "and even now, but now," cannot have the force of adversative particles. What, then, shall we do with them? How shall we explain them? I confess I see no remedy but an alteration of the text, and I take my cue from a passage in this identical play. We have a similar contrast of past and present in I., i., 4—

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[*] When the author wrote this, he was not aware of the fact that Collier's annotator had proposed the same alteration. This was pointed out to him by Mr. Tinling, who also suggested a further very ingenious emendation, viz., to read (l. 3), "happier *in* this," for "happier *than* this."

"And in a word, *but even now* worth this,
And now worth nothing."

We see from this passage that, whereas "but even now" refers to the past, the present is indicated not by "but now," but by "and now." Let us apply what this passage teaches to the passage under consideration, and we shall find that by the simple transposition of "and" and "but" we shall restore sense and grammar, as the verse will then read—

"Queen o'er myself, but even now;—and now
This house, these servants, and this same myself,
Are yours."

VII.

III., ii., 22—

"*Bassanio.* And do you, Gratiano, mean good faith?
Gratiano. Yes, faith, my lord.
Bassanio. Our feast shall be much honour'd in your marriage.
Gratiano. We'll play with them the first boy for a thousand ducats.
Nerissa. What, and stake down?
Gratiano. No; we shall ne'er win at that sport, and stake down.
But who comes here? Lorenzo and his infidel?
What? and my old Venetian friend, Salerio?"

As this passage is printed in our editions, it is really in a sad state. We have prose and verse jumbled together, and verses of all lengths. It is not difficult to restore it to perfect metre by a few slight alterations.

"*Bassanio.* And do you mean good faith?
Gratiano. Good faith, my lord.
Bassanio. Our feast shall be much honoured in your marriage.
Gratiano. We'll play with 'em, the first boy a thousand ducats.
Nerissa. What, and stake down?
Gratiano. No; we shall never win
At that sport, and stake down. But who comes here?
Lorenzo and his infidel? What, and
My old Venetian friend, Salerio?"

The only alterations made are—1st. The omission of the unnecessary word *Gratiano* in the first verse. 2nd. The spelling of "'em," for "them," by which the two words, "with them," can be contracted into one (as in "Julius Cæsar," I., ii., 38, 12). 3rd. The omission of "for," which also is superfluous.

VIII.

III., ii., 41—

"The dearest friend to me, the kindest man,
The best condition'd, and unwearied spirit,
In doing *courtesies;* and one in whom
The ancient Roman honour more appears,
Than any that draws breath in Italy."

In this glowing description of the high and noble qualities of his friend *Antonio*, it is clear, that *Bassanio* does not take the word "courtesy" in the sense in which alone it is now current, and which makes it equivalent with civility and urbanity—things pertaining not to a man's morals, but rather to his manners. The meaning Shakspere attaches to the word is more honourable to Antonio; it is evidently used as synonymous with "kindness." This is borne out by another passage in the same play. III., i., 17—

"He was wont to lend money for a Christian courtesy."

And by *Lear*, II., iv., 55—

"O Regan, thou shalt never have my curse,
Thou better know'st
The offices of nature, bond of childhood,
Effects of *courtesy*, dues of gratitude."

IX.

III., ii., 44, 5—

"Should lose a hair through Bassanio's fault."

This verse lacks a syllable, which Symmons has supplied by reading—

"Should lose a hair through *my* Bassanio's fault."

But there is no occasion to add a word. We need only spell and read "thorough" instead of "through," and the rhythm is unexceptionable.

X.

IV., i., 28—

> "To cut the forfeiture from that bankrupt there."

This verse has one syllable too many; but Shakspere wrote—

> "To cut the *forfeit* from that bankrupt there."

XI.

IV., i., 76, 9—

> "From such misery doth she cut me off."

This verse halts, and must be restored by reading—

> "From such *a* misery doth she cut me off."

XII.

IV., i., 95, 7—

> "Of one poor scruple; nay, if the scale *do* turn."

This lame verse can easily be cured by omitting the unnecessary auxiliary *do*. The termination of the verse is then, *if the scale turn*. This termination looks faulty at first sight, at least, if we apply the laws of classical versification. For there it is a fundamental principle that the last foot of every verse should represent the pure rhythm. The rhythm of the blank verse is iambic; the last foot, therefore, we might think, should not consist of two such words as *scale turn*, which can only be considered a spondee, and not an iambus. What makes this apparent neglect of the true iambic rhythm still worse, is the circumstance that in the preceding foot, *if the*, the rhythmical accent (the arsis) is on the short, insignificant article. I must confess this kind of verse is not pleasant to my ear. But they are so frequent in Shakspere, that we must look upon them as perfectly legitimate, and need not hesitate to introduce them in an emendation. In the "Merchant of Venice," alone, we have the following examples:—

II., i., 3—

"Pluck the young sucking cubs from the she-bear."

III., ii., 37—

"I have engaged myself to a dear friend."

IV., i., 91—

"I take this offer then: pay the bond thrice."

IV., i., 106—

"Therefore thou must be hang'd at the states' charge."

XIII.

IV., i., 133—

"And if your wife be not a mad woman."

The rhythm of this verse seems even more irregular than that of those we had just now under consideration. For here the last foot deviates more from the iambic rhythm than a spondee. It is a pure trochee, and, therefore, the verse reads precisely like a Greek skazon, *i.e.*, limping iambic verse, where the last foot is regularly and purposely a trochee, in order to produce a peculiar and almost ludicrous effect. But, upon closer examination, much of this oddity disappears. The expression, "mad woman," namely, is to be considered, not as two words, but as a compound substantive, the feminine of "madman." There is a difference in the accents on "mádman" and "mad mán"—the first is a trochee, the second an iambus. Just so, "mad wóman" differs from "mádwoman." The former has the accent on the penultimate, the latter on the antepenultimate. Now, by a fundamental law of the English language, in every word of three syllables, that syllable which immediately adjoins the accented syllable can, in poetry, be used as an unaccented (or short) syllable; and that syllable which immediately adjoins this short or unaccented syllable—and is, therefore, separated by it from the accented syllable—receives a secondary accent, and can, therefore, be used as long. Thus, in devoteé, disregárd, entertáin, the antepenultimate receives a secondary accent; in májesty, próvident, tówering, the ultimate does the same. Applying this rule to the word madwoman, we shall find that it can be scanned as amphimacer mádwomán, or in other words, that the second part of it, the word "womȧn" can change its original accent from that of a trochee to that of an iambus.

XIV.

V., i., 24—

> "*Jessica.* I am never *merry*, when I hear sweet music."

It is worth while to inquire what is the precise meaning of "merry." Surely, *Jessica* cannot mean to say that music makes her sad. She speaks in general of "sweet music," not of solemn adagios, only, that melt the heart, and produce that sweet, softening melancholy, so soothing and delightful. To get at the true meaning of "merry," we must widen the enquiry, and compare the opposite of "merry," viz., "sad." There is an obvious connection between "sadness" and "attention," "thoughtfulness" and "reflection;" and between "mirth," and "thoughtlessness," and "inattention." Thus, in "Midsummer Night's Dream," IV., i.—

> "Then, my queen, in silence *sad*,
> Trip we after the night's shade.

"Winter's Tale," IV.—

> "My father and the gentlemen are in *sad* talk."

Here, as Warburton observes, *sad* signifies only *grave*, *sober*. Blackstone quotes a statute—3 Henry VII., c. xiv., which directs certain offences, committed in the king's palace, to be tried by twelve *sad* men of the king's household. Here we have the *judex tristis* of Latin phraseology, who is not a sad melancholy judge, but one composed to serious attention and gravity, the very opposite quality of that which characterises the reveller and the merry-maker. This connection between mirth and thoughtlessness is exemplified in Goldsmith's "Deserted Village," 122—

> "And the loud laugh that spoke the *vacant* mind,"

and 255—

> "Spontaneous joys, where nature has its play,
> Lightly they frolic o'er the *vacant* mind;"

and, on the other hand, how closely correlative are sadness and thought is shown in the same poem, v. 136—

> "The sad historian of the *pensive* plain"—

where "pensive" evidently means "mournful." *Jessica,* therefore, in saying she is not merry when she hears sweet music, means to imply that she cannot think of anything else —that she is riveted by music—that she must listen and attend to it; and this is precisely the sense in which Lorenzo takes it, and which he fully explains by saying—

> "The reason is, your spirits are attentive."

NINTH ORDINARY MEETING.

ROYAL INSTITUTION, 18th February, 1861.

The Rev. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Dr. THOMSON having resigned his seat in the council, the Society was informed that Mr. MOORE, curator of the Free Public Museum, had been elected in his place.

Mr. MOORE exhibited a very fine specimen of a seal (*Callocephalus vitulina*), lately caught in the Canada Dock. The specimen has been well stuffed and mounted, and is about to be placed in the Museum, to which it was presented by Mr. Hulse, of Dale-street. Mr. Moore also exhibited a very beautiful and interesting series of forty-four Canadian woods, lately presented to the Free Public Museum by Mr. Richard Reid Dobell.

Dr. IHNE having taken the chair, the PRESIDENT proceeded to read the paper of the evening,

ON "DARWIN'S THEORY OF THE ORIGIN OF SPECIES" (CONTINUED).

"SPECIES NOT TRANSMUTABLE." BY DR. BREE. (*Athenæum*, Nov. 3, 1860.)

AFTER a short, but, on the whole favourable notice, of the above-named work, by Dr. Bree, the reviewer proceeds to give his own reflections, consequent upon a second perusal of Mr. Darwin's theory. These reflections seem to have been much influenced by the tone of Dr. Bree's work, from which the following is an extract:—"I cannot conclude without expressing my detestation of the theory, because of its unflinching materialism; because it has deserted the inductive track, the only track that leads to physical truth; because it utterly repudiates final causes, and thereby indicates a demoralized understanding on the part of its advocates." The question, can there be any just ground for such charges as these? if it be worth asking at all, seems necessarily to take precedence of every other inquiry on the subject. Are we then really, under the guise of philosophical inquiry, discussing whether or no there be a final cause? The theory, it is said, utterly repudiates final causes; then must its supporters be regarded as atheists. Details of natural history, however interesting, sink into insignificance if the controversy can reasonably be viewed under this aspect; for let it be remarked that the theory is accused of inconsistency, not with the Mosaic account of the creation, but with any belief in an Almighty Creator; and, in this respect, the accusation differs entirely from that which was brought against what was, not very long since, the geological theory, but which is now geological science. It is well known how various have been the accommodations by which geologists have satisfied themselves of the consistency of the Mosaic account with their science; some have extended the six days into as many geological periods; one distinguished author considers the narrative of the creation to be an account of a vision seen by the sacred writer. In one way or in another, those who think it desirable to reconcile the letter of the Mosaic account with the "Testimony of the Rocks," succeed in doing so, at least to their own satisfaction.

But against the theory of the derivation of species, we have a charge which admits of no possible accommodation; which must be either false or fatal. Now, even if we are ready at once to pronounce it false, it is by no means uninteresting to inquire what is the gravamen in Mr. Darwin's theory on which is founded so solemn an indictment. It is to be hoped that the charge of repudiating a final cause is not brought against the theory because of its discrepancy with the Mosaic account of the creation. All real friends of the cause of revealed truth will deprecate its advocacy by any such means. We must, then, look to some more general view of creation, such as is supposed to be essential to the idea of a Creator, and examine if, with this, Mr. Darwin's theory can be shown to be incompatible. It seems, then, to be essential to any reasonable view of a Creator that the very existence of things should be regarded as having emanated simply from His will, without the employment of means of any kind, for such means would have to be created, and we are now speaking of the first origin of things. It seems also essential that the continuance of things should be regarded as the result of His approbation and constantly sustaining power. And as these seem to be essentials, so they seem to be the only essentials to the reasonable acknowledgment of a Creator. I am not aware of anything in Mr. Darwin's theory opposing the reception of these propositions. But it has been very generally held that at whatever period of the history of the world any kind of living thing has first appeared, it has been the immediate result of a purely creative act, and we are now told that to question this is to question the existence of a final cause.

Now, if we turn from the organic to the inorganic world we shall there find no traces whatever of anything analogous to the successive acts of creation by which, as it is supposed, species were first produced. From the very beginning there has been one uniform course; not a trace can be found of any second touches. The laws of motion, of gravitation, of chemical affinity, of the distribution of light, heat, and electricity, have undergone no changes since the inconceivably remote ages of the Silurian formation. I see no reason for regarding this as inevitable. It is quite possible to conceive a course of things entirely different. The Will that at first worked without means could, at any subsequent time, have dispensed with them, and there might have been a world and an universe in which the phenomena of matter might have constantly presented the immediate results of supreme volition, just as species are supposed to have presented such results when first created. But who does not see that in such a world the position of man would be very different to that which he now occupies? Nature would wear an aspect wholly impenetrable. All material changes springing directly from the one great cause would, equally with that great cause, be inscrutable. Man's mind might be heaven-taught, but from earth he would learn nothing. From such a state of things the first exception, if it should please the supreme will to make one, and to employ a simple means to bring about a simple end, would be like the first beam of light; and just in proportion as these exceptions became more numerous, and the all-prevailing will abstained from acting immediately, retiring further and further from material results, and employing principles and laws, which, after all, are only other names for means, just in such proportion would the phenomena of matter become charged with instruction, until, as it is now, the limit of their teachings would be found in the ability of man's intellect to receive them.

In the inorganic world of which we are speaking, elementary bodies hold a position somewhat analogous to that of species in the world of life; yet no one suspects any want of reverence towards a final cause in the suggestion that the truly elementary bodies may be much fewer than has been supposed. In the age when water was deemed to be an element, the question—How does water exist? would have been properly answered by a reference to the will of the Creator. We now know that water exists by the combination, under certain electrical conditions, of hydrogen and oxygen. Has our increased knowledge dishonoured the Creator? And if this is only one out of a thousand instances—if the dominion of law has no assignable limits—if the Creator has worked by means behind means indefinitely extended—why is it but that His operations might form a boundless field for man's investigation It is not contended that this or any other argument drawn from analogy in the inorganic world can prove the theory of Natural Selection; thus far, however, I think it is valid—it serves to show that the question of the origin of species may and must be open to fair investigation, without liability to the charge of impiety, on the ground of repudiating the existence of a first and final cause.

In the world of living creatures, we are far from regarding the life of any being as the immediate result of the Creator's will. A multitude of ascertained facts, relating to the sustenance and the reproduction of plants and animals, indicate the employment of means innumerable and profound. It may yet happen that our knowledge may be still further extended, and that we may become acquainted with the laws which have governed the first introduction of species. If this should be the case, we may be quite sure the increased light will only reveal more of the benificient design with which the Creator has made provision for something of His own excellencies to be discernible in His works. It is, therefore, with regret that we read in a periodical professedly devoted to the cause of literature and science, remarks so little conducive to sound reasoning and truth as the following:—

"What does he really mean, for instance, by this Natural Selection, to which so much is attributed? If it operates as a presiding principle through innumerable ages—if it selects, assorts, distinguishes and preserves—if it gathers up manifold small increments, and rejects parts obsolete and unsuitable—if it aggrandizes small increments into great and long-enduring results—if it exercises a power that never fails, that is never hindered and never weakened—if it foresees its end through millions of years, and through all these years is ever controlling imperfection and contributing to perfection—and we think we find all these potencies variously, though vaguely, ascribed by Mr. Darwin to his supposed principle—if, we say, Natural Selection is and does all this—then it is either God, or it is a pestilent abstraction. If it be God, why not say so in the plain language of many men? If it be not God, what is it that you are attempting to set up upon altars where men usually worship Him? What is this wonderful power, to which you would give what most men regard as the inalienable prerogatives of Deity? Do not reply that, though it exists, we can know nothing of it—do not carry us back to Athens, where men ignorantly worshipped an unknown God. What is its significance? Is it human, or divine, or organic—a substance, an essence, or a shadow?"

Mutatis mutandis, all that is here said of Natural Selection, unfairly and with exaggeration, might fairly be applied to gravitation in combination with the laws of motion. If it operates as a presiding principle through innumerable ages—if it prevails to the extent of the known universe—if it preserves order and has the power of eliminating elements of disorder—if it exercises a power that never fails, that is never weakened—if all things, the greatest as well as the most minute, are subject to it—if gravitation is, and does all this, which is truly the case, then, by the reviewer's argument, gravitation must either be God, or it is a pestilent abstraction.

Mr. HIGGINS proceeded to notice several other reviews, confessing his dissent from Mr. Darwin's theory, but regretting the manner in which it had been attacked.

TENTH ORDINARY MEETING.

ROYAL INSTITUTION, 4th March, 1861.

The Rev. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The Rev. H. J. HINDLEY, M.A., and the Rev. C. D. GINSBURG, were elected members.

Mr. MOORE exhibited a beautiful British fungus (*Peziza coccinea*), and some Myrabolans, covered with a Sphæria, probably of East Indian origin.

Mr. C. SPENCE remarked that he had never observed a similar growth upon the vast number of nuts that passed through his hands.

Mr. **Duckworth** exhibited a remarkably fine specimen of Apophyllite, a mineral allied to zeolite, from the Bore Ghât, between Bombay and Poonah.

Dr. **Collingwood** referred to the death of the old lion at the Regent's Park, which was found stretched one morning on the floor of its den. Messrs. F. Buckland and Quekett (of the Royal College of Surgeons), having examined it, came to the conclusion that it died of congestion of the lungs. A lion which lately died in Liverpool, Dr. Collingwood had the opportunity of examining. He found extensive pulmonary congestion, sufficient to cause death in this animal, which had been ailing for some weeks, having taken cold during its transit to this town in severe weather.

Dr. Collingwood also called attention to a paper, by Prof. Asa Gray, of Harvard University, reprinted from the *Atlantic Monthly Magazine*, entitled a "Free Examination of Darwin's Theory," and read from it some passages in which that eminent naturalist endeavoured to combine the two theories of *specific creation*, and *derivation of species* in a manner which would render the latter far less objectionable, particularly when it had to do with the introduction of the human race.

The following paper was then read :—

NOTES ON EARTH TEMPERATURES.

By DAVID WALKER, M.D., F.L.S., &c.

As the temperature of the earth performs a very important part in the promotion of vegetation, it has lately attracted the particular attention of meteorologists and naturalists, and I shall, in this paper, briefly touch upon the most important results deduced from comparisons of observations made in different parts of the world. In the consideration of the subject of terrestrial temperature, we must distinguish three different modes for the transmission of heat. The first with which we have to deal is, the varying amount of heat which penetrates from above downwards, or from below upwards, consequent on the different positions of the sun and the seasons of the year; this forms the most important source of heat, and is the principal agent in the maintenance of the different varieties of plants exhibited by the various zones of the earth that succeed each other, from the equator to the poles. The second mode of transmission, although present, is extremely slow, and has but little influence on the temperature of the earth near the surface—I refer to the heat which is propagated from the equatorial regions towards the poles, which heat being absorbed into the interior of the earth moves off laterally to those spots where the temperature is lower. The third mode, although the slowest of all, yet is ever acting, and has played a very important part in the former economy of our globe. During the solidification of the globe—which is commonly conjectured to have been gaseous and subsequently fluid, and to have been originally heated to a very high temperature—an enormous quantity of latent heat must have been liberated; this source of heat, existing in the centre of the earth, has been clearly demonstrated by direct thermometrical observation in mines and artesian wells, and most unquestionably by the flow of molten masses from open fissures and volcanoes. The thinness of the crust of the earth in former epochs of its history, in the opinion of geologists, accounts for the presence of plants and animals in strata situated in latitudes too cold in our day to maintain such tropical productions. The rate of increase in the temperature of the earth, corresponding to the depth, has not been very accurately determined, as it partly depends upon the character of the strata through which the borings are made. The average increase of heat is 1° for every 56 feet; the artesian well at Grenelle, near Paris, shows an increase of 1° for every 59 feet. The temperature of the salt spring at Oeynhausen is 91°·04, an increase of 1° for every 54½ feet. I may here remark that the French philosopher Poisson denies that this increase of temperature is dependent upon the internal source of heat, and supposes that this warmth in the water of artesian wells is merely that which has penetrated into the earth from without, and the earth itself "might be regarded as in the same circumstance as a mass of rock conveyed from the equator to the poles in so short a time as not to have entirely cooled." It is a question often asked, whether the mean temperature of the surface of the earth has experienced any considerable change in the course of years? This is a question which has yet to be answered, as the comparatively recent general use of the thermometer causes a dearth in the means at our disposal for the investigation of this subject; we know, however, that the mean heat of the globe has not altered during the last 2,000 years, as the length of the day has not diminished by the hundredth part of a second, the length of a day being proportionate to the heat of the earth.

The periodic changes of temperature which have been occasioned on the earth's surface by the sun's position are continued into its interior, although to a very inconsiderable depth; the slow conducting power of the ground diminishing this loss of heat in the winter is very favourable to deep-rooted trees. Points that lie at different depths in the same vertical line attain the maximum and minimum of the imparted temperature at very different periods of time; the further they are removed from the surface the smaller being the difference between the extremes. According to the accurate observations of Quetelet, *daily* variations of temperature are not perceptible at Brussels at the depth of $3\frac{4}{5}$ feet below the surface, and that at the same place, at 25 feet depth, the highest temperature was not indicated until Dec. 10th—the lowest was only observed on June 15th. Forbes, in his experiments on Calton Hill, found that at the depth of 24 feet in trap, the maximum temperature was not registered until January 8th. In Paris, Arago found that very small differences of temperature were perceptible 30 feet below the surface. The difference between the highest and lowest annual temperature diminishes in proportion to the depth, and, according to Fourrier, the difference diminishes in a geometrical proportion as the depth increases in an arithmetical ratio. We thus see that in every place there must be a certain depth at which the temperature will remain steady, and not fluctuate, according to the transmitted external heat—this is called the stratum of invariable temperature; and it depends not only upon the latitude of the place, and the conducting power of the strata, but also upon the amount of difference between the hottest and coldest seasons of the year. In our latitude the depth at which this stratum is found varies from 60 to 90 feet. At Paris, the temperature of the caves underneath the observatory is considered to be the temperature of the invariable stratum—this occurs at a depth of 86 feet, the temperature being 53°·30 F., the mean temperature of the air being 51°·48 F. At any depth of about 25 feet the influence of the seasons scarcely affects the oscillations of the thermometer to the extent of half a degree. In tropical climates the invariable stratum is only some 10 to 14 inches below the surface. In the arctic regions, the depth of this stratum varies considerably. In the country of the Samoyedes in 67° N. latitude, ice was found at the depth of 5 feet in summer. In the Ural Mountains, 59° N. latitude, 5 feet was also the depth of the first-found ice. In Finmark, the temperature does not become so low as that of frozen soil. Franklin found, in August, that the ground was frozen at 16 inches' depth in the N.W. part of America. Richardson, upon the more eastern part of the coast in 71° N., found the depth, in July, to be 3 feet. The average of a number of observations which I made at Bellot Straits shews, in August, a depth of 14½ inches as the extent to which the summer thaw had penetrated; the depth varied from 12 to 17 inches, dependent upon the nature of the soil, being in some places clayey, in others mostly made up of shingle and mud. Seeman, the naturalist of the "Herald," in 1849, found that the depth of the summer thaw at Port Clarence, in Behring Straits, 66° N. latitude, extended from 2 feet in some places, to 4 or 5 feet in others, the latter occurring in sandy soil. On the northern coast line of America, Sir John Richardson found the depth of the thaw to extend only to 14 inches from the surface.

During the winter of 1858-9, I recorded the temperature of the soil at Port Kennedy, 72° N., 94° W., at two different depths. On the 14th September, I sunk a brass tube containing a delicate thermometer, vertically, 2 feet 2 inches in the soil. I found the ground frozen from 6 inches below the surface—the upper six inches was loose shingly soil, beneath it was a hard frozen yellowish mud—in sinking the tube more than one pickaxe was broken, so hard was the soil; the temperature of the ground was 31°·2. From the 4th October the surface of the ground over this thermometer became covered with snow, increasing in thickness till it was 84 inches deep;

the thermometer was registered every three or four days: it showed a pretty gradual decrease in the temperature until March 10th, when it was 0°·5. The mean temperature of the air during December being −32°·98; that of January, −33°·53; that of February, −36·06, *i.e.*, the mean winter temperature having been −34°·2. I may state that the mean annual temperature of this place was +2°·22; the mean summer temperature 37°·3. From the 10th March the temperature of the sunken thermometer gradually rose until July 11th, when it was at its highest, 31·8. The superincumbent snow at this time had all melted away, yet the three months' constant sunshine had not caused the ground at this depth to thaw; seeing that the mean summer temperature is only 37°·3, this may not be wondered at, but if we look at the direct amount of heat imparted to the ground from the sun's rays, it would be expected that the thaw would have penetrated more than 14½ inches. I have registered the black-bulb thermometer at 101°·5, the temperature in the shade being 49°·0; from the 28th April to the 28th July, the black-bulb thermometer never showed a temperature below 50°, with one exception, the temperature of the shade varying from +6 to +52°, thirty of those days the black-bulb being above 75°; yet the direct radiation of the sun during all spring and summer, until the declination has altered, is only employed in removing the covering of snow and ice which had accumulated during the winter, and producing a thaw to the extent of some 14 inches. On the 10th of March, a thermometer placed on the ground above where the 2 feet 2-inch thermometer was sunk, and covered by the superimposed snow, shewed its lowest temperature, namely, −3·8, indicating that at this time of the minimum temperature in both thermometers, the covering of snow created a difference of temperature of 4·3° between the deep ground and surface thermometers. On the 26th of February, another thermometer sunk 1 foot 1 inch through shingly soil, uncovered by snow, shewed its minimum −25·7, the temperature of air at the time being −38·2, the mean temperature for 9 preceding days having been −37°·4. The temperature registered by this thermometer gradually rose from the 26th February to the 28th July, when it shewed its maximum 44°·8, the temperature of air being 42·9, and the mean air temperature for previous 9 days being 42°·6.

From this series of experiments, the difference between the loose shingly soil and the close mud, as to their heat-transmitting power, will be evident; also the effect of a covering of snow in preventing nocturnal radiation; and also in moderating the direct influence of the sun's rays.

It will be evident from these, and also from similar experiments made in other parts of the world, that the mean temperature of the soil at certain fixed points from the surface is, to a great degree, the cause of the climatic and agricultural differences of any district, such temperatures being dependent upon the temperature of the air, and the nature of the surface covering of the ground at those places. This leads me to the consideration of the temperature of the earth as to its hypsometrical relation, or as it regards its altitudinal range. As the temperature of the air decreases about 1° for every 350 feet in height, it follows that the relative temperature of the earth will also decrease; we thus ultimately reach the line of perpetual congelation, or the snow line; its limit does not exactly correspond with the height at which the temperature is equal to 32° F. In the tropics, the height of the snow line is some 15,000 feet, whilst at 70° N. it comes down to 1,700 feet; and at the poles it will be at a minimum height, 0. The same changes which take place from the equator to the poles, on the level surface ground, will also occur on lofty mountains, such heights regulating, in a great measure, the vegetation, so that we may have an arctic flora in the tropics. Although the mean annual temperature of many places in lat. 75° N., be as low as zero, yet the snow line is not so low as one would imagine. Near the poles, the direct rays of the sun are aided by the radiation and reflection of its rays from large tracts of land, compensating in a great degree, the obliquity of the sun's rays during the evening and night; the heat is also increased by the presence of currents of warm water moderating the cold winds. In ascending a mountain at Disco Island, about 70° N., I found plants of Saxifraga, Cerastium, Salix, and Draba up to 2,500 feet, and the first two up to 3,000 feet; at 3,350 feet, I found the Cerastium alpinum, also lichens adhering to the rocks where they had been denuded of snow by the direct rays of the sun. I found six species of Saxifraga, with many other phanerogamic plants, and lichens, at 1300 feet high, on a mountain at the head of Port Kennedy, 72° N., 94° W.

A few words, in conclusion, as to the mode of taking earth temperatures. Meteorologists generally, now, confine their observations to a very moderate depth in this climate. Of course, in foreign lands where new observations would be of great value, such statement does not hold true. Ranges from the surface of the ground to depths of 3 feet are those most generally used. One set of experiments is of considerable value, namely, the register of a thermometer whose bulb is just covered with a thin sprinkling of earth, exposed to the rays of the sun. At 6, 13, 19½, 26, and 39 inches, the temperature is now pretty widely recorded. The usual mode of registering is, to sink a brass tube, closed at the one end, vertically through the soil to the required depth, and to place in it a delicate thermometer, with a long stem, having its bulb well padded, so that the temporary exposure of the thermometer to the air, whilst it is being read off, may not affect its indication; the upper end of the tube may be protected by a sod of earth laid on it. Another method is to place in the ground a thermometer having its stem enclosed in wood up to the surface of the earth, the stem continuing upwards above the surface, having a metal scale with the degrees marked upon it. I think both these means of registering defective, and have used for some months past a different mode. I had a tube of wood made 9½ inches long, and at its lower extremity I attached a brass tube of 3½ inches, this was sunk in the ground; instead of having a long thermometer in this tube, I obtained a small one 3½ inches long finely graduated to read easily to one-tenth of a degree. I find that this instrument answers admirably, giving more correct readings than either of the other two. For three months, I have compared the results shown by all three instruments. I find that the metal of the brass tube conducts not only the temperature of the air, but also the temperature of the upper part of the soil, so that the thermometer registers the temperature not at 13 inches depth, but of the whole 13 inches of soil through which the tube passes. The wooden instrument, also, is open to objection, as not only the wood, but also the long glass and contained mercurial stem, are influenced by the temperature of the air, &c. The object of the wood in the upper portion of my instrument is to reduce the conduction from the air to a minimum; whilst the 3½ inches of metal gives the temperature of the soil at that depth to the thermometer, which is only the same size.

I do not wish to enter into the question of isothermal, isotheral, or isocheimonal lines—it would enlarge this paper beyond my wishes. I may conclude by stating that the comparison of temperatures of the earth or soil at moderate depths, and the deductions to be drawn from them, are of great importance not only to the physiological, but also to the practical, botanist.

The following paper was also read—

ON MR. C. W. WILLIAMS' THEORY OF "HEAT, IN ITS RELATION TO WATER AND STEAM."

BY THE REV. W. BANISTER, B.A.

AFTER a short preliminary introduction, the Rev. W. BANISTER said—I shall endeavour, this evening, to lay before you, briefly and popularly, some of the salient points in Mr. C. Wye Williams' lately published work on "Heat, in its relation to Water and Steam."

Mr. Williams makes, what will seem to most people, the startling assertion, that water cannot be *heated,* and still retain its liquid form and character—that there is no such thing as hot water—that the liquid which we use in shaving, in which we infuse our tea or coffee, with which we mix our grog, or in which we plunge our feet when we have a cold in the head, is not, correctly speaking, hot at all; the *liquid* in the tea-kettle, in the fiercest state of ebullition, is no hotter than when it came out of the pump; it is cold water and hot steam mixed.

The foundation, then, of his theory is, that—beyond that temperature at which water must be under a given pressure to be fluid, and not ice—it is impossible to add heat without turning a given portion of the water into vapour or steam, which are convertible terms, the force of the latter being due, not to any difference in its nature, but in quantity—vapour is steam, and *vice versâ.*

Mr. Williams extends the operation of Dalton's celebrated law of the diffusion of gases so as to include the vapour of water.

According to that law, the tendency of the ultimate atoms of which *liquids* are composed, and of those of which *gases* are composed, is directly contrary; the ultimate atoms of a *liquid* tend to run together, to unite—those of a *gas*, to fly off and separate; the one kind are mutually attractive—the other mutually repellent—their natures are utterly diverse. A drop of water will form a bead at the bottom of a tumbler—the same bulk of gas or vapour will expand and fill the whole of the vessel.

Hitherto, it has been denied that vapour of water obeys this law; Dalton made no reference to it, Mr. Williams thinks, out of deference to the great genius of Watt, but that both would now readily include it; for Watt conceived that steam could not come into contact with water without being condensed; but Mr. Williams has carried steam generated in one vessel through a succession of four or five more without condensation. Heat is applied to the first, and steam is generated to the point of saturation—it then flows through a pipe from the top into the second vessel of cold water, gradually saturates this with vapour, and so on; it might be carried through an unlimited series if the first vessel were supplied with water. Indeed, Dalton said—"Vapour cannot, on any scientific principle, be classed in a distinct category from elastic fluids, retaining its elasticity and repulsive power among its own particles."

Mr. Williams, therefore, assumes as proved that the vapour of water behaves as all other elastic fluids do. *In whatever medium they are, dense or rare, water or air, they arrange themselves so as to pervade the whole of it*—equally—as if they were in a vacuum; and to diffuse themselves downwards as well as upwards, though the latter more quickly.

If you apply heat beneath and against the whole of the bottom of a vessel of water, the temperature in the *mass* is increased with remarkable uniformity. [This was here illustrated by experiments.] This cannot be due to the conduction of heat by the water, for water is considered as a non-conductor; nor to the water revolving, and having all its particles heated in succession, for the *temperature becomes homogeneous instantly on the heat being applied, and long before there is time for this to take place.* Again, the heat of the steam in the space above the water-line is the same as that shewn in the water; so that unless steam and water can be of the same temperature—which he thinks impossible—the identity of temperature must be due in both cases, *i.e.*, in and out of the water, to the same cause, steam, pervading water and air alike; and, moreover, on the escape of steam, the temperature is suddenly reduced.

Before bringing before you some of the experiments which confirm Mr. Williams' views, it may be well to quote the opinions of writers of scientific eminence, who give different explanations of the phenomena in question. Vid. p. 31, 33, et seq., in Mr. Williams' book on "Heat, in its relation to Water and Steam:"

On the application of heat to the bottom of a vessel containing water, the lowest stratum of liquid particles in contact with the bottom will be instantaneously converted into vapour—from being attractive they will become mutually repellent—they will become specifically lighter, and have a tendency to rise, and their volume will increase as they ascend in consequence of the diminution in pressure. They will not ascend with strict regularity, but, owing to the descent of heavier particles of water meeting them, will adopt a sinuous and wavy direction. The layer of liquid which succeeds them is treated in the same way, and sent up after the first; if the process be continued, all will be turned into steam. If, when the water is charged with a considerable quantity of these vapour atoms, or particles, you look through it by the light of a lamp placed on the farther side, you will *see* the steam ascending, like spirit in water, distinctly. If the heat be continued, the whole of the water will be saturated with vapour, and the thermometer will indicate 212°, or boiling point; but there need be no ebullition—if the water be perfectly pure there will be none. (Experiment.) But that the steam *is* in the innocent-looking liquid will be plain if you introduce a wooden stick or rod. Wherever you place the point, steam collects—where does it come from, if not in the water? the cool rod cannot generate it. To make this more clear, let us take a vessel in which a permanent source of attraction is set up in the form of a cross made of pounded brick, stuck on by paint. It is thus shewn, says Mr. Williams, "that the ebullition is purely accidental, and has no reference to the *generation* of vapour, and that it is solely the result of the aggregation of myriads of atoms *previously* formed, and irrespective of the heat transmitted and absorbed in any particular locality."

To shew the force of the ascensional power of steam atoms, Mr. Williams puts a quantity of pounded coal into a vessel of water, through which the steam forces its way—forcing the particles upwards like so many explosions.

Mr. Williams denies that water is expansible, as it is acknowledged to be nearly incompressible. He requires the application to liquids of the admitted law as regards solids—"that dilatation and compression are correlative terms."

"If," he says, "dilatation and compression are treated as being reciprocal and proportionate when spoken of in relation to solids, why draw a contrary inference in relation to liquids? If iron *contracts considerably under cold, and expands considerably in same proportion under heat*, why not say that, as liquids are nearly incompressible, they must be nearly inexpansible?"

Again, water wanting the power of readily conducting heat from one particle to another, cannot communicate a sufficient amount of heat to make the *mass* expand, as would be the case in a solid; for, if one particle cannot *give*, its neighbour cannot *receive* heat from it. If you insert a long tube in a flask of water, so that the water shall rise a certain height in the tube, and apply heat to the bottom of the flask, the column of water in the tube will at first *fall*, because the glass, though solid, expands more quickly than the water, so allowing the latter more room; it will soon rise, however, but the expansion is due to the larger bulk of the particles of steam generated, and not to the expanded water.

With regard to condensation, Mr. Williams contends that steam is not condensed by cold water, for several reasons:—

1st. If steam were condensed by contact with cold water, the *first steam generated* must be *immediately* condensed by the cold water with which it would be at first in contact; you never could get beyond a succession of vaporisations and condensations—no *body* of vapour could be formed.

2nd. A small jet of steam discharged into a large body of water is capable of almost instantly raising the whole to 212°.

3rd. Steam, as we have seen previously, may be carried through a series of vessels containing cold water.

I shall only add a short notice of his theory regarding the interesting subject, both to cooks and captains, of Boiler Explosions.

If I rightly understand him it is, that explosions rarely occur from deficiency of water, any further than that such deficiency may cause injury to the boiler plates from over-heating; but they arise from the sudden escape of the steam contained *in* the water. (Of course, on his principle, the more water the more steam.) If, then, the engine has been at rest for some time, but heat continuously supplied to the bolier, both the water in the boiler and the space above it will be *heavily charged* with steam; *so long as the equilibrium is maintained all will be well;* but if, from any cause—such as the injection of water from the feed pipe, producing a tumultuous aggregation of steam atoms, or by opening the valves and starting the engine—a quantity of steam be suddenly liberated, a tremendous rush of steam, both from the chamber above, and from the body of water, carrying a quantity of the latter with it, and gaining increased momentum on escaping from the denser medium, hurls itself with such precipitation at the valve (like a mob to the door where a theatre is on fire), that it misses its object, and is thrown violently against the crown of the boiler; and should any part of this be previously at its maximum strain, the impetus is irresistible.

The paper was illustrated by experiments in proof of Mr. Williams' views, under the charge of Dr. Edwards.

ELEVENTH ORDINARY MEETING.

Royal Institution, 18th March, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. T. S. Walker, M.R.C.S., and Mr. G. Searle Wood, were elected members.

The names of numerous visitors were announced.

Mr. J. O. Fabert exhibited several beautiful specimens of Gorgonia, &c., from the West Indies, and some remarks were made by the Chairman upon their peculiar mode of growth.

Mr. Moore exhibited a large collection of furniture and ornamental woods, the produce of the Canadian forests. They consisted of forty-five specimens, comprising ash, birch, cedar, elm, maple, chestnut, walnut, oak, &c., and were collected by Mr. William Quinn, supervisor of Cullers, Quebec, who was present, and made some remarks concerning them.

Dr. **Collingwood** read an extract from a private letter which he had received from Professor Agassiz, of Cambridge, U.S., in which that gentleman proposed to enter into a correspondence with the society for exchange of specimens between the museums. He had referred the subject to Mr. Moore, of the Derby Museum, by whom it had been warmly taken up, and who had taken advantage of the return of the steamship "Canada" to send the professor a small packet as an earnest of future correspondence. The letter of Mr. Agassiz had been kindly brought him by Captain Anderson, of the Cunard steamship "Canada," a gentleman who took a great interest in thesubject of Natural History, and who was willing to be the medium of communication with Prof. Agassiz.

Dr. **Collingwood** also referred to a memorial to the Committee of the Mercantile Marine Association, extracts from which he read to the meeting, in which was proposed a scheme for the encouragement of studies among the captains and sailors of the Mercantile Marine, which might be expected to improve their own morals and benefit science. It further insisted upon the value which would accrue from the more general collection by such men of natural objects from all parts of the world for the enrichment of our museum, and recommended them to avail themselves of the opportunities which would be offered by the proposed School of Science. Dr. Collingwood announced that this memorial had been that day laid before the committee of the Mercantile Marine Association, by whom it was favourably received, and ordered to be printed; and would, moreover, appear in *The Albion*, of the following Monday (March 25), an announcement which caused general satisfaction to the meeting.

Mr. **Henry Duckworth** explained briefly, with the aid of a chart, the leading points in Mr. Consul Petherick's expedition to the sources of the Nile, which is intended as an auxiliary to the prime expedition already dispatched to the same goal by way of Zanzibar, under the conduct of Captains Speke and Grant. Supported by an escort furnished him by the amiable Prince of Zanzibar, Captain Speke will retrace his steps to the point of his last important discovery, the Lake Victoria, Nyanza. The intervening country being peopled by comparatively friendly tribes, the travellers will experience only the ordinary difficulties of transport during their passage through it. It is in their progress northward to Gondokoro from Lake Nyanza, which will be thoroughly explored with a view to determining whether or not it is the mother of the Nile, that the party will encounter the greatest difficulties, for not only, according to Mr. Petherick, are the languages of the aborigines different from those known south of the equator, but, unaccustomed to strangers, their hostility towards them, and to neighbouring tribes is very great. Again, unless the expedition reaches Gondokoro in December or January, when Khartoum traders visit the place for the purpose of barter, it will be unable to proceed down the Nile, and, after a drain upon its resources of from twelve to fifteen months (the time which Captain Speke calculated it will take to reach Gondokoro from Zanzibar), its position will be not a little critical. It is at this point that Mr. Petherick proposes to step in. Setting out from Khartoum, his first object will be to form a sufficient depôt of grain at Gondokoro, under the charge of his own men, to ensure to Captain Speke means of subsistence and security from violence whenever he should reach that place. 2ndly. To explore the country between Galuffi and Lake Nyanza; and, 3rdly. To effect a meeting with Captain Speke, and assist him through the hostile tribes between the Lake and the Nile. Mr. Petherick estimates that the cost of this additional expedition will be only £2,000. "Spes sit mihi certa videndi Niliacos fontes, bellum civile relinquam," are words which Lucan has put into the mouth of Julius Cæsar; but, judging from the manner in which the people of

Britain have responded to the appeal of the Royal Geographical Society, they are far from being actuated by the same spirit. Little more than half the necessary amount has as yet been subscribed. Nevertheless, Mr. Petherick has nobly determined to adhere to his original plan, and endeavour to reach Gondokoro next November. He will then explore until March, 1862, when the setting in of the rainy season prevents further movements. Starting afresh in August, 1862, he proposes to continue his travels till February, 1863, and after that to return to Gondokoro, reaching his depôt at the end of 1863, or early in 1864. By last accounts, dated 15th October, Captain Speke was at Kidunda, in lat. 7° 20' S., and lon. 38° 8' E.

The following paper was then read:—

THE PARSEE RELIGION.

By DADABHAI NAOROJI, Esq.

(Professor of Gujarati in the University of London.)

Like a soldier suddenly called to perform his movements before a body of veteran officers, after having given up his military habits for several years, I feel embarrassed and awkward on being required to read a paper before a learned society such as this, after having been, for the past six years, unused to the habits of thought, reading, and composition, necessary for such a task. I have endeavoured, however, to do what I could, under the circumstances, and as far as my limited leisure permitted.

I will first give some account of the present state of the knowledge of the Parsees about their religion. The priests are a separate caste, and the priesthood is thus hereditary. As a body, the priests are not only ignorant of the duties and objects of their own profession, but are entirely uneducated except that they are able to read and write, and that, also, often very imperfectly. To read and write they must learn, as they have to prepare by rote a large number of prayers and recitations, which, in the performance of their usual avocations, they are required to recite. Their work chiefly consists of reciting certain prescribed prayers on various religious occasions; to go to the fire-temple or sea-shore, and say a prayer for anybody that chooses to give a halfpenny; and to depend upon charities distributed on various joyous or mournful occasions. They do not understand a single word of these prayers or recitations, which are all in the old Zend language.

From the state of their education and knowledge, they are quite unfit for the pulpit; nor do they aspire to it, or seem to have any notion of the necessity of such teaching. The Parsees have, therefore, no pulpit at present. Far from being the teachers of the true doctrines and duties of their religion, the priests are generally the most bigoted and superstitious, and exercise much injurious influence over the women, especially, who, until lately, received no education at all.

The priests have, however, now begun to feel their degraded position. Many of them, if they can do so, bring up their sons in any other profession but their own. There are, perhaps, a dozen, among the whole body of professional priests, who lay claim to a knowledge of the Zend Avestá, the religious books of the Parsees; but the only respect in which they are superior to their brethren is, that they have learnt the meanings of words of the books as they are taught, without knowing the language, either philologically or grammatically. They have been taught certain meanings for certain words, and they stick to them as a matter of course. I doubt much whether any one of them has a clear notion of what grammar is, and as to a liberal education, they never had it, and do not, in consequence, understand the necessity of it.

Such being the state of knowledge of the religious guides and teachers among the Parsees, it may be easily conceived what could be expected from a layman. The whole religious education of a Parsee's child consists in preparing by rote a certain number of prayers in Zend, without understanding a word of them; the knowledge of the doctrines of their religion being left to be picked up from casual conversation. Under these circumstances, a Parsee has not much opportunity of knowing what his creed really is; the translation, besides, of the Zend books, in the present vernacular of the Parsees, being of very recent date. But, unfortunately, this translation is a constant subject of dispute among the dozen would-be learned priests alluded to before. This shameful want of the means of religious education, and its slight extent among the Parsee children, have of late attracted the attention of the community, and efforts are being made to supply the deficiency.

In my ignorance of the Zend language, I cannot do more than depend upon this translation, though considered to be somewhat imperfect. But, for the purposes of a paper like this, the object of which is to give a general outline of the doctrines of the Parsee religion, I think these materials will suffice.

The traditional number of the books of the Zend Avestá is twenty-one, of which there are only three extant, and parts of two more, viz., the Yazashné, the Vandidád, and the Khordeh Avestá, and a part of the Visparad, and Vistásp Nusk.

There is a dialogue, in the vernacular, appended to the Khordeh Avestâ (small Avestá), which, I think, gives a sufficiently accurate outline of the present belief of nearly the whole of the orthodox body. I do not know of a certainty who its author is. It has been composed more than a quarter of a century ago, when English ideas and education had not made much progress; and is, therefore, I think, the more valuable, as a faithful representation of the belief of the general mass.

The Khordeh Avestà is a collection of prayers addressed to God and several angels, and it is some of these prayers, the preparation of which by rote, forms the staple of the religious education of the Parsee child. At the end of this book is appended the dialogue, in the vernacular; and intelligent priests, masters, and parents, that could read, welcomed this aid, imperfect though it is, and a little irrelevant.

The subject of the dialogue is thus described:—

"A few questions and answers to acquaint the children of the holy Zarthosti community with the subject of the Mazdiashná religion (*i.e.*, of the worship of God). Dialogue between a Zarthosti master and pupil:—

Ques. Whom do we, of the Zarthosti community, believe in?

Ans. We believe in only one God, and do not believe in any besides Him.

Ques. Who is that one God ?

Ans. The God who created the heavens, the earth, the angels, the stars, the sun, the moon, the fire, the water, or all the four elements, and all things of the two worlds ; that God we believe in—Him we worship, Him we invoke, and Him we adore.

Ques. Do we not believe in any other God ?

Ans. Whoever believes in any other God but this is an infidel, and shall suffer the punishment of hell.

Ques. What is the form of our God ?

Ans. Our God has neither face nor form, colour nor shape, nor fixed place. There is no other like Him ; he is Himself singly such a glory that we cannot praise or describe Him ; nor our mind comprehend Him.

Ques. Is there any such thing that God even cannot create ?

Ans. Yes ; there is one thing which God himself even cannot create.

Ques. What that thing is, must be explained to me.

Ans. God is the creator of all things, but if he wish to create another like Himself, he cannot do it. God cannot create another like Himself.

Ques. How many names are there for God ?

Ans. It is said there are one thousand and one names ; but of these one hundred and one are extant.

Ques. Why are there so many names of God ?

Ans. God's names, expressive of his nature, are two, "Yazdan" (omnipotence), and "Páuk" (holy). He is also named "Hormuzd" (the highest of spirits), "Dádár" (the distributor of justice), "Purvurdegár" (provider), "Purvurtar" (protector), by which names we praise him. There are many other names, also, descriptive of his good doings.

Ques. What is our religion ?

Ans. Our religion is, "Worship of God."

Ques. Whence did we receive our religion?

Ans. God's true prophet—the true Zurthost [Zoroaster] Asphantamán Anoshirwán—brought the religion for us from God.

Ques. Where should I turn my face when worshipping the holy Hormuzd?

Ans. We should worship the holy, just Hormuzd with our face towards some of his creations of light, and glory, and brightness.

Ques. Which are those things?

Ans. Such as the sun, the moon, the stars, the fire, water, and other such things of glory. To such things we turn our face, and consider them our "kibleh" (literally, the thing opposite), because God has bestowed upon them a small spark of his pure glory, and they are, therefore, more exalted in the creation, and fit to be our "kibleh" (representing this power and glory).

Ques. Who was this true prophet, the true Zurthost?

Ans. The son of Porosaspé, who was the son of Pétéraspé, was the excellent Zurthost Ashphantamán Anoshirwane—chief of the wise, and the king of the learned—the worshipper of God. Him did God exalt over all mankind, admitted to his own presence; and by him did God send us his good Mazdiashná religion. *He* has been our prophet.

Ques. Have we had any other prophet after Zurthost?

Ans. No; we should remain attached with sincere faith to the religion brought by him.

Ques. Among the creation of Hormuzd in this world, which is the most exalted, and which the lowest?

Ans. The great prophet is the most exalted, and that prophet is the excellent Zurthost—none is higher than he; the height of dignity culminates in him, because he is the most beloved and honoured of God. The servant of all is iron.

Ques. What religion has our prophet brought us from God?

Ans. The disciples of our prophet have recorded in several books that religion. Many of these books were destroyed during the Alexandrian conquest, the remainder of the books were preserved with great care and respect by the Sassanian Kings. Of these again the greater portion were destroyed at the Mahommedan conquest by Khalif Omar, so that we have now very few books remaining, viz., the Vandidad, the Yazashné, the Visparad, the Khordeh Avesta, the Vistasp Nusk, and a few Pehlvi books. Resting our faith upon these few books, we now remain devoted to our good Mazdiashna religion. We consider these books as heavenly books, because God sent the tidings of these books to us through the holy Zurthost.

Ques. What other books had we during the times of our kings?

Ans. Innumerable on all subjects of learning, but the enemies of our religion and sovereignty translated them in their own languages, and thus, after usurping our wisdom, destroyed our ancient Persian and Pehlvi works.

Ques. In what king's time did our prophet live?

Ans. When a just and God-worshipping king, by name Gushtàshp [Hystaspes] the son of Lohorósp reigned. When Jámásp was the sage, and Rustam the great warrior, did our prophet bring the Mazdiashna religion from God. He performed many miracles and refuted the sages of Greece and India by such miracles; then the King Gushtáshp, the sage Jámásp, and the sages of Greece and India, believed in the religion brought by Zurthost and accepted it.

Ques. Are our prophet's miracles recorded any where?

Ans. Long accounts were recorded in our ancient books, of which we have some portions extant. The wise and learned Greeks of the time had also recorded the miracles and wisdom and truth of our prophet, but their ignorant successors have, from envy, altered and misrepresented those records. Notwithstanding this, there are still some evidences in the old Greek books.

Ques. What religion prevailed in Persia before the time of Zurthost?

Ans. The kings and the people were worshippers of God, but they had, like the Hindoos, images of the planets and idols in their temples. This religion is now designated the Poriódakesi, which appears to be a mistake, for it seems the religion of the Persians before Zurthost, was called Farsandaji Kós, and its followers Farsandaji Kisán, while it is those that adopted Zurthost's religion, were called the Poriodekesians.

Ques. Whose descendants are we?

Ans. Of Gayomars. By his progeny was Persia populated.

Ques. Was Gayomars the first man?

Ans. According to our religion he was so, but the wise men of our community, of the Chinese, the Hindoos, and several other nations, dispute the assertion, and say that there was human population on the earth before Gayomars.

Ques. What commands has God sent us through his prophet, the exalted Zurthost?

Ans. Many are those commands, but I give you the principal, which must always be remembered and by which we must guide ourselves:—

To know God as one; to know the prophet, the exalted Zurthost, as his true prophet; to believe the religion and the Avestá brought by him, as true beyond all manner of doubt; to believe in the goodness of God; not to disobey any of the commands of the Mazdiashná religion; to avoid evil deeds; to exert for good deeds; to pray five times in the day; to believe in the reckoning and justice on the fourth morning after death; to hope for heaven and to fear hell; to consider doubtless the day of general destruction and resurrection; to remember always that God has done what he willed, and shall do what he wills; to face some luminous object while worshiping God.

Ques. If we commit any sin, will our prophet save us?

Ans. Never commit any sin under that faith, because our prophet, our guide to the right path, has distinctly commanded "you shall receive according to what you do." Your deeds will determine your return in the other world. If you do virtuous and pious actions, your reward shall be heaven. If you sin and do wicked things, you shall be punished in hell. There is none save God that could save you from the consequences of your sins. If any one commit a sin under the belief that he shall be saved by somebody, both the deceiver as well as the deceived shall be damned to the day of "Rastá Khez," (the day of the end of this world). * * *

Ques. Have any persons endeavoured to deceive the people by offering to intercede for them and to save them?

Ans. Some deceivers, with the view of acquiring exaltation in this world, have set themselves up as prophets, and going among the labouring and ignorant people, have persuaded them that, "if you commit sin, I shall intercede for you, I shall plead for you, I shall save you;" and thus deceive them, but the wise among those people know the deceit. They do not, however, dare to speak their mind for fear of the deluded multitude. Our prophet needed no exaltation here, he was exalted before God, and he told us the true command, "you shall receive according to your deeds." There is no saviour. In the other world you shall receive the return according to your actions.

* * *

Your saviour is your deeds, and God himself. He is "Bakhsháyandé," (the pardoner), and "Bakhsháyazgar," (the giver). If you repent your sins and reform, and if the great judge consider you worthy of pardon, or would be merciful to you, he alone can and will save you.

Ques. Why are God and his prophet addressed in the rude singular "thou," instead of the polite plural "you?"

Ans. Because God is only *one*, and there is none like him, and there is only *one* prophet.

Ques. What are those things by which man is blessed and benefitted?

Ans. To do virtuous deeds, to give in charity, to be kind, to be humble, to speak sweet words, to wish good to others, to have a clear heart, to acquire learning, to speak the truth, to suppress anger, to be patient and contented, to be friendly, to feel shame, to pay due respect to the old and young, to be pious, to respect our parents and teachers. All these are the friends of the good men and enemies of the bad men.

Ques. What are those things by which man is lost and degraded?

Ans. To tell untruths, to steal, to gamble, to look with wicked eye upon a woman, to commit treachery, to abuse, to be angry, to wish ill to another, to be proud, to mock, to be idle, to slander, to be avaricious, to be disrespectful, to be shameless, to be hot-tempered, to take what is another's property, to be revengeful, unclean, obstinate, envious, to do harm to any man, to be superstitious, and do any other wicked and iniquitous action. These are all the friends of the wicked, and the enemies of the virtuous.

Such is the religious knowledge which the Parsees of more than a quarter of a century ago endeavoured to communicate to their children, or at least wished them to be taught, but I do not think that even this dialogue had been, till very lately, made a necessary part of the child's religious education. From one question quoted, not quite bearing upon the Parsee religion, but evidently meant for a reason against Christianity, it may have struck the reader that this dialogue was perhaps written under the pressure of the efforts of Christian missionaries to convert Parsee youths.

It remains, however, to be seen how far the doctrines and injunctions taught in this dialogue are authorised by the Zend Avestá, and what other doctrines are taught in them. The best thing I can do, I think, is to give here a series of extracts from the translation of one of these Zend books, sufficient to give a faithful general notion of the doctrines and morality of the Zoroastrian religion.

I have given extracts from only one of the books, as I have not had time enough at my disposal to study and extract from the others. This book, the Yazashné, is divided into seventy-two chapters called "Há." Of the first "Há," I give an abstract of almost the whole, as from it will be at once obtained some idea of the peculiarities of this religion:—

"The great judge, Hormuzd, full of glory and brightness, I invoke. The highest, the all-virtuous, the greatest, the strictest, the all-wise, of the purest nature, the holiest, lover of gladness, the invisible among the invisible, the increaser. He created our soul—He moulded our body—He gave us existence. Him I invoke, and complete this Yazashné. Good conscience, high piety, love of excellence, high and perfect thought, Khordad and Amardad, the sheep and their souls, the fire of God, all other angels that reach us, the time of day which is exalted by holiness, the early dawn—all these I remember or invoke in this Yazashné. The morning angels "Sawang" and "Vis" that are exalted by holiness, the angel "Meher," the lord and guardian of the forest of thousand ears and ten thousand eyes, gladness and comfort, the noon time of day and its angels, "Furádádáre" (Fasé) and "Jand." The afternoon time of day and its angels, "Furádádare Vir," and "Deh," exalted by holiness. The angel "Burzo," of the source of water, and the waters created by God. The night time of day and its angels, "Furádádáre Visp," "Hujivas," and "Zurthosturotum," the holy souls of men and women, the year that is spent in virtue and excellence, and the great and brave, created by God, beautiful and victorious. [I know not who is meant here—the translator puts in the angel "Behram."] The time after midnight and its angels, "Berej," and "Numan," exalted by holiness, the angel "Surosh," the prayerful and victorious, and the promoter of things in the world, the just "Rashné," and "Astad" the bestower of freshness to creation—all these I invoke or remember, and complete this Yazashné. The months that are exalted by holiness, the six Ghumbars (the feasts of the seasons, which are all named). The year, exalted by holiness, the chiefs that are great by holiness, the three and thirty that surround the "Howanim," that are shown by Hormuzd and communicated by Zurthost. [I cannot tell what these are; the translators apply this description to the thirty-three implements of the ceremonial]. The holy, high, and immortal angel "Meher" the king of cities, the stars, the bright star "Tester," the moon, and the glorious sun, rider of the fleet horse, created by God, and the ocean of light—all these I invoke or remember, and complete this Yazashné." All the angels of the thirty days of the month, of the twelve months, of the five "Gathas" (the intercalary days), are each then invoked by their respective names, in their order.

"The glorious fire, created by God, the water that is created by God, all the vegetable creation of God, the holy and high angel "Marespund," whose justice is not of the wicked "dews" (the evil spirits); such is also the justice of Zurthost—the long-enduring ways of the good Mazdiashná religion (religion of the worship of the almighty)—these I remember or invoke, and complete this Yazashné.

The holy mountain "Hoshdostar," created by God, all mountains created by God, the glory of the "Kayanian" kings of Persia, created by God, the glory of the holy priests, created by God, the good angel "Arsesung," of great intelligence and wisdom, glorious, and bestower of benefits, created by God, the virtuous, the good, prayerful, and holy men, and the angel "Daham," of high thought—all these I invoke or remember, and complete this Yazashné.

This place, and cities, and forests, and places of comfort, and water, and land, and trees, this whole earth, the sky, the holy wind, the stars, the moon, the sun, the God-created immeasurable light, all the holy angels, and all pure creation that is exalted by holiness, I remember or invoke, and complete this Yazashné.

The *Highest Lord*, who is all purity, the Lord of the days, of the months, of the year, of the Ghumbars, Him I invoke at this early dawn, and complete this Yazashné.

The holy and powerful departed soul of the "Poriodakesi," my own soul, all the angels of both worlds, created by God, who are exalted by their holiness, the five times of prayer of the day and their angels—all I invoke or remember."

This first "Hà" ends with the following prayer:—

"If I have by thought, word, or deed, intentionally or unintentionally, not kept thy commands, and thereby saddened thee, I invoke thee in this invocation, I pray to thee, and praise thee, and beseech thee for thy pardon."

A somewhat similar prayer is made to all the angels, and then follows;—I learn the Zurthosti religion, the worship of God, which is different from that of the dews (the evil spirits), and is like the justice of God.

In the above extracts, I have not repeated the words "I invoke," and "remember," as often as they do actually occur in the original, and I have said "I invoke or remember," by which I mean that all spiritual objects are invoked, and all material ones remembered.

The next five chapters are almost in the same strain and style, with several additions among the objects of invocation and remembrance, such as "light proceeding out of God himself, the soul of the prophet made an 'Izad' (angel) by God; God, the creator of all things, of light, the eternal, the omnipotent."

In the course of these six chapters, as also in many others, God and the angels, and the various objects of creation, are addressed in various ways, such as "I love," "I honor," "I praise," "I remember," "Consider holy," "I gladden," "I invoke."

"Há 7.—I accept, and am glad to do deeds of virtue. May I receive the reward for piety through your bounty. O great and wise Lord, the reward that is due to the religious, may I and mine receive; that reward may thou give from thy stores of bounty in such a way, in this and the spiritual world, that I may be exalted; and may I live for ever and ever under thy all-holy leadership and all-virtuous protection. I understand "honwar" exalted, and truth-telling exalted. I praise the virtuous, the good, and the prayerful.

Há 8.—O God, in thy creation, those that are virtuous and follow thy commands, to them give thou water and fruit, and over all good things of this world, such as they desire, give them command. May the aspirations of the holy be fulfilled. May the wicked and the evil-doers be disappointed, and be swept away from the creation of the holy creator.

I, that is Zurthost, of the Hormuzdi and Zurthosti religion, I rise up before all the others, of the streets, and of the towns, and of the cities, and with highly good thoughts, highly good words, and highly good deeds, pray for freedom and ease to the community of holy men—to the wicked I pray for hardship and destruction."

Há 9 contains a dialogue between Zurthost and the angel Hom. I do not know what the duties of this angel are. He is described by Zurthost, in his personal interview with him, as the destroyer of death, and created holy. In reply to Zurthost's inquiries he names four persons who prayed to him, and obtained the desire of their prayers, in having sons born to them of glorious names and deeds. The four persons are, 1st. Vingham, the father of the great Jamshed, during whose reign there was no death. 2nd. Athwian, the father of the great Faredoon, the vanquisher of Zohac, the tyrant and scourge of mankind. The 3rd, the warrior Sam, the father of the great hero, Kershasp, who destroyed the dragon, Sarronny, full of poison and destruction, and of the holy and pious Ornakhsh; and the 4th, Porosusp, the father of you holy and just Zurthost. Zurthost, then, praises him as exalted in the presence of the great God, by his virtuous and holy deeds, and prays to him to assist him in destroying all that is evil and wicked, and to bestow on him the power of doing good. "The first request I make, O Hom, the destroyer of death, is, may I attain the abode that is full of rest and glory, reserved for those that are holy. The second request I make of you, O Hom, the destroyer of death, is, may my present body enjoy good health. The third request I make, O Hom, the destroyer of death, is, may I live a long life. The fourth virtue I ask from you, O Hom, the destroyer of death, is, may I do like those, who, with courage and gladness, pursue, in this world, the path of righteousness, and destroy whatever is evil. The fifth virtue I ask, O Hom, the destroyer of death, is, may I do as those brave men, who, in battle, fight gloriously to destroy oppression and wickedness. The sixth virtue I ask from you, O Hom, the destroyer of death, is, may I know, beforehand, the intrigues of the enemies, the attack of the thieves and the wolves; teach me to thwart the evil designs of the wicked, the impious, and the deceiver."

Hom is then described as the inspirer of courage and strength in the warrior and his steed; the bestower of children and good husbands, the inspirer of wisdom to the student of learning, the disappointer of those rulers who wish destruction to the worshippers of God, the just, the distinguisher of good from evil, &c. "The king and the 'durwesh' of good conscience are equal before your eyes."

The 10th and 11th Há are also in praise and description of the power and duties of Hom. In one place, the person praying, or Hom, I cannot tell which, says—"I am among those of virtuous thoughts, and not among those of wicked thoughts. I am among those of virtuous words, and not among those of wicked words. I am among those of virtuous deeds, and not among those of wicked deeds. I am among the obedient performers of God's commands, and not among the disobedient. I am among the holy men, and not among the sinful.

12th Há, in which, as in several other places, is enjoined to protect and take care of the helpless sheep; and after a general prayer for the good and against the wicked, ends thus—"I (the person praying) am of the religion of "the worship of God." I praise that religion, and declare it before the wicked, and praise it with good conscience, virtuous words, and virtuous deeds," &c.

From the 12th to the 18th Há, are invocations and acknowledgements of the power and goodness of God, the greater and smaller angels, all things spiritual and material in creation, the thirty angels of the days of the month, &c., &c., as in the first seven Hás.

From the 19th Há, I give more extracts: Zurthost asks God—"Tell me, O great invisible God, the creator and promoter of all creation, what were thy words before the existence of the heavens, before the waters, the world, the harmless sheep and other animals, before the trees, before the glorious fire, created by thee, O Hormuzd, before the holy man, before the wicked spirits of dull reason, before all thy creations in the world, and before all the good and holy things created by thee—what were thy words?" God replies thus—"O supentaman Zurthost, those words were the parts of "Honwar"—those that I have told you; these were my words before the heavens, before the waters," &c., &c. [The parts of the "Honwar" are explained by the translator to mean the twenty-one books or parts of the religion of God, promulgated by Zoroaster.]

"O supentaman, whoever shall learn or repeat, without wearying, these parts of "Honwar," shall attain a hundred times greater superiority than by learning or repeating any other holy words. Him shall I pass over the "Chinwad Púl" (the bridge in heaven over which the souls pass on the fourth morning after death), and admit him to the paradise of the holy that is full of glory. Whoever shall forget these holy words shall have his soul kept at a distance from the glorious paradise, at the same distance at which his soul shall be from his body, at a distance of the whole length of the world. Before I created the heavens, before the waters, &c., I created Khurshed (the sun) to give light to the universe. The great body of the holy men that have been, that are, and that will be, is so holy on account of obeying the commands of God, and having done other good deeds. Whoever shall study and meditate much upon the words of the "Honwar," and recollect them, and act according to them, after death shall attain to everlasting exaltation. All the days of the holy man are with thoughts of truth, words of truth, and deeds of truth. The high priest is he who is learned in the religion, and whose whole life is devoted to the promotion of righteousness in the world.

Há 20.—Whoever tastes the pleasure of righteousness, which is above all other pleasures, and walks in righteousness, shall be perfectly holy; he is virtuous, who walks in virtue among the holy men, and is true to them.

Há 24.—The righteous are immortal.

Há 30.—He who knows God through His works reaches Him.

Há 31.—Zurthost asks—'What is the reward to the holy and good from your bounty, and what is to become of the heathen and the wicked?' Hormuzd replied—'On the day of reckoning the wicked shall be destroyed (I am not quite sure of the word which I have translated destroyed); those that are hostile to the virtuous—to the harmless animals and men—those that tell untruths and do wicked actions, shall not receive the reward of life from Hormuzd. He only shall receive the reward, at the time of reckoning, who in his heart believes in God, and does not injure the promoters of holiness. To speak true words is true excellence. He who leads the holy man astray, there is bewailing and moaning for his soul after death, and for a long time his soul has to live in the abode of darkness, to suffer great hardships—that dark abode which is for the wicked; your evil deeds shall draw you to it.'

Há 33.—Zurthost says—'The wicked are punished according to their thoughts, and words, and deeds. Better it is that they be introduced to a taste of learning. O Hormuzd! give them a desire for wisdom, that they may become the promoters of holiness. Give me, O Hormuzd, the two desires, to see and to self-question.'

Há 34.—'O Hormuzd, I worship thee, and in the heavens, also, I shall worship thee much. What, O Hormuzd, is thy will, what thy worship, and what is thy invocation?' God replies—'See and adorn holiness—learn my ways of holiness with a good conscience.' 'Tell me, O Hormuzd, the ways of good conscience.' 'To be glad with the religion of the good, with virtuous deeds, and with holiness.'

'For holiness and purity, I ask the aid of Ardibeshest (angel of fire); for pure thoughts, I ask the aid of Bahaman, and I ask Sharevar's aid. I worship thee, O Hormuzd, above all others—I invoke thee above all others. All virtuous thoughts, all virtuous words, and all virtuous works flow from thee. O Hormuzd, I invoke thy pure nature, above all others.'

'By my deeds may I (says Zurthost) exalt and honour thy name. Under the protection of thy great wisdom have I acquired wisdom; may I reach thee; may I always be firm in thy friendship, and in holy deeds.'"

Há 44 contains a series of questions from Zurthost to God, among which occur the following, and in which the interrogation implies the reply—"If not thou:"—

"O wise Hormuzd, I ask of thee, what is the greatest exaltation in this world? How can any, who wishes benefit to himself, be holy, promote virtue, be the beloved of Hormuzd among the creations. O wise Hormuzd, I ask, who is the creator and promoter of holiness? How have the revolutions of the sun and moon been created? How does the moon wax and wane? O Hormuzd, give me the knowledge of these? O Hormuzd, I ask, who has made the earth stand unsupported? Who has created the waters and the trees? Who has created the air which flows of itself with such force? Who has created Bahaman? Who has created the receiving of light and of darkness? Who has created the times of the day, and the time of reckoning and judgment? Who has created the desire to be exalted through virtuous thoughts? Who has created the affection that the child receives from the father? O Hormuzd, I hope more from thee than from all others. Thou art the promoter of all goodness—the holy Hormuzd—Thou art the creator of all creation.

Say to me—How may my soul attain to the gladness of both worlds? How may I impart purity to this religion—that the virtuous and wise may learn greatness, and Bahaman (good conscience), and Ardebehest (high virtue), enter their hearts and abide there; and, in the treasures of religion, exalt truth above all?

What is the high religion? The reply—That which promotes my holiness and truth with good thought, word, and deed.

O Hormuzd, give me thy wisdom and treasure that I may rejoice. O wise Hormuzd, whoever is holy questions himself; whoever is wicked rejects this my religion that benefits. How do the evil-disposed suffer annihilation, who do not subject themselves to self-reflection through Bahaman (good conscience)? When is the time of resurrection and final judgment? How can one deserve the reward of ten young horses and camels? Thou gavest to Khordad and Amardad this reward—this reward thou givest to the truth-speaker. Who are those sinners whose end is destruction? O Hormuzd, why may not these sinners become virtuous? Who will destroy them? The reward of the unholy, of the deceivers, of the outragers of justice, and the destroyers of the harmless animals, shall not be like that of the holy and virtuous.

Há 45.—To those that are conscientiously religious, and are promoters of religion, God is friend, brother, and father.

Há 46.—May all men and women of the world become my followers, and become acquainted with thy exalted religion, that I may rise in thy praise and in thy religion with prayer; and pray with a pure conscience.

Whoever accepts Zurthost's religion, praises it, and meditates on it, and studies it much, to him God gives a place in the other world, and in this world Bahaman (good conscience) gives him exaltation. Sinners of wicked thoughts, wicked words, and wicked deeds, of wicked doctrines, have to their souls presented bitter and detestable food in that well-known and permanent house of the wicked spirits.

Há 51.—I bless all good men and women that have been, that are, and that shall be. May they enjoy for ever and ever the invisible treasure, according to their desire. May water, and sheep, and vegetation, afford all comfort to them. May the inflictions of evil spirits and evil men never approach them.

Há 55.—O Mazdiashnans! desire to invoke the pure Surosh."

This Surosh is described to be the guardian and protecting angel of this world. He protects men from the evil spirits of hell, and of Màzandaran, from all that is evil, anger, and injustice, &c.

"Há 56.—I invoke the benefit and success of prayer: to arrive at prayer is to arrive at a perfect conscience : the good seed of prayer is virtuous conscience, virtuous words, and virtuous deeds. May our prayer be efficacious in thwarting the inflictions of wicked spirits and wicked men. May I love prayer to Hormuzd, for that prayer is joy to me. I resort to prayer, I invoke prayer. Prayer to thee, O Hormuzd, is the giver of excellence, holiness, success, and high exaltation—it is the act of virtue. May the fold (of sheep) of the people of this street not diminish—may virtue not diminish—may the strength of the holy men not diminish—may not Hormuzd's justice diminish—may the good and exalted holy souls arrive here—may the virtue of the virtuous endure, and may wickedness vanish. In this house—may obedience prevail over disobedience, peace over quarrels, charity over hard-heartedness, good thoughts over bad thoughts, words of truth over words of lie, piety over sin.

Há 59.—I enjoin on earth, and in heaven to study the "Honwar." I enjoin holiness on earth and in heaven; that to pray much to Hormuzd is good, I enjoin in heaven and on earth. I enjoin the holy and the virtuous, and the prayerful, on earth and in heaven, to punish the evil spirit and his works, which are wicked and full of death—to punish the thief and the tyrant—punish the magicians of cruel intentions—punish the breakers of promise, and those that induce others to break their promise—to punish the harassers of good and holy men—to punish the evil thoughts, words, and deeds of the sinful."

Hás 62 to 64.—The angels of fire and water, and other angels are prayed to for several sorts of benefits and blessings; among others, a son who would help and protect him, and be a worthy man—who would not wish ill to anybody—who would not hurt anybody with any arms—who would not seek revenge, nor do harm.

I now arrange some of these extracts under different heads, as inferences derived from them. To avoid repetition, I shall not, under each head, give all the texts corroborative of it.

The Parsees believe in only one God, the creator of all.

"1st Há.—The great judge, Hormuzd, of glory and brightness, the highest, the all-virtuous, the greatest, strictest, the all-wise, of the purest nature, the holiest, lover of gladness—the invisible to the invisible, the increaser—He created our soul—He moulded our body—He gave us existence. Há 34.—I worship thee, O Hormuzd, above all others, I invoke thee above all others, all virtuous thoughts, all virtuous words, and all virtuous works, flow from thee. O Hormuzd, I invoke thy pure nature above all others. By my deeds may I exalt and honour thy name. Under the protection of thy great wisdom have I acquired wisdom. May I reach thee. May I always be firm in thy friendship and in holy deeds."

In Há 44 several extracts relate to this subject, especially God as the creator of all, ending in "Thou art the Creator of all Creation."

In a prayer to Hormuzd (Hormuzd Yasht) occurs this—"My name is the Creator of all."

Zurthost worships God not only in this world, but in the heavens also—Ha 34, "O Hormuzd, I worship thee, and in the heavens, also, shall I worship thee much."

The Parsees believe in the existence of angels, created by God, with powers to aid and benefit mankind in various ways, and to be the superintending spirits of the various parts of creation. The chief among these are the angels of good conscience (Bahaman), and of high piety (Ardebehsht); the former is also the protecting angel of the harmless animals, and the latter the angel of fire.

"1st Ha.—I Invoke good conscience, high piety, love of excellence, high and perfect thought, Khordad and Amardad; all other angels that reach us; the angel "Meher," the lord and guardian of the forest, of thousand ears and ten thousand eyes, of gladness and of comfort." Many other extracts can be made to deduce the above inference.

The various parts of creation are praised, or remembered, or considered holy, &c.

The first seven Hás contain many texts illustrative of this.

"The fire created by God, the time of day, the early dawn, the waters created by God, the year that is spent in holiness, the moon and the glorious sun, the ocean of light, the stars, the immeasurable light, the mountains and the trees, the forest, the sheep, and the harmless animals;" in short, nature, in her various parts and phenonena, is sometimes praised, sometimes remembered, sometimes described as holy.

As far as I have seen, there is no text in which any lifeless material object without intelligence or spirituality is invoked for assistance or benefit. Such prayers are always directed to intelligent spirits or angels, and to God above all, and as the Creator and Lord of all.

The Parsee believes in the immortality of the soul, and in rewards and punishments after death.

"Hà 7.—O great and wise Lord, the reward that is due to the religious, may I and mine receive; that reward mayst thou give from thy stores of bounty in such a way, in this and the spiritual world, that I may be exalted, and may I live for ever and ever under thy all-holy leadership, and all-virtuous protection.

Há 8.—May the aspirations of the holy be fulfilled, may the wicked and evil-doers be disappointed, and be swept away from the creation of the holy creator. The righteous are immortal."

Extracts from Há 31 bear on this point.

Notwithstanding the abhorence of evil and evil-doers, the Parsee is made to wish that the wicked may be converted to virtue.

"Há 33.—The wicked are punished according to their thoughts, and words, and deeds. Better it be that they be introduced to a taste of learning. O Hormuzd, give them a desire for wisdom, that they may become promoters of holiness.

Há 44.—O Hormuzd, why may not these sinners become virtuous."

The Parsee rests his pardon on the mercy of God, and his reward on the bounty of God.

"Há 1.—If I have by thought, word, or deed, intentionally or unintentionally, not kept thy commands, and thereby saddened thee, I invoke thee in this invocation, I pray to thee and praise thee, and beseech thee for thy pardon.

Há 7.—May I receive the reward for piety through your bounty."

The morality of this religion is comprised in the three words, pure-thought, pure-word, and pure-deed; and holiness, virtue, prayers, &c., are praised and exalted, and inculcated in many places.

" Há 7.—I praise the virtuous, the good, and the prayerful.

Há 19.—The high-priest is he who is learned in the religion, and whose whole life is devoted to the promotion of righteousness in the world.

Há 20.—Whoever tastes the pleasure of righteousness, which is above all other pleasures, and walks in righteousness, shall be perfectly holy. He is virtuous who walks in virtue among holy men, and is true to them.

Há 34.—What, O Hormuzd, is thy will, what thy worship, and what thy invocation? God replies—See and adorn holiness—learn my ways of holiness with a good conscience. —Tell me, O Hormuzd, the ways of good conscience.—To be glad with the religion of the good, with virtuous deeds, and with holiness.

Há 56.—May the virtue of the virtuous endure, and may wickedness vanish. In this house, may obedience prevail over disobedience, peace over quarrel, charity over hard-heartedness, good thoughts over bad thoughts, truth over words of lie, and piety over sin.

Hà 59.—I enjoin on earth and in heaven to study the "Honwar." I enjoin holiness on earth and in heaven. That to pray much to Hormuzd is good, I enjoin in heaven and on earth. I enjoin the holy, and the virtuous, and the prayerful, on earth and in heaven, to punish the evil spirit and his works, which are wicked and full of death—to punish the thief and the tyrant—punish the magicians of cruel intentions—to punish the breakers of promise, and those that induce others to break their promise—to punish the harassers of good and holy men—to punish the evil thoughts, words, and deeds of the sinful."

Truth is particularly inculcated.

"Há 7.—I understand truth-telling exalted.

Há 19.—All the days of the holy man are with thoughts of truth, words of truth, and deeds of truth.

Há 31.—To speak true words is true excellence."

The Parsee believes in the necessity and efficacy of prayer.

"Há 56.—I invoke the benefit and success of prayer. To arrive at prayer is to arrive at a perfect conscience; the good seed of prayer is virtuous conscience, virtuous words, and virtuous deeds. May our prayers be efficacious in thwarting the inflictions of the wicked spirits and wicked men. May I love prayer, O Hormuzd, for prayer is joy to me. I resort to prayer, and I invoke prayer. Prayer to thee, O Hormuzd, is the giver of excellence, holiness, success, and high exaltation; it is the act of virtue.

Há 59.—To pray much to Hormuzd is good, I enjoin in heaven and on earth."

The study of the religion is considered most meritorious; and the holy word (the Zend Avestá) is said to have been created by God before all creation. Extracts from Há 19 all refer to this subject.

"Há 44.—What is the high religion ? That which promotes holiness and truth with good thought, word, and deed.

Há 19 declares "Honwar" (the word of God) to have been created before the heavens, before the waters, before all creation; and that whoever studies them without wearying shall attain to the paradise of the holy, which is full of glory.

Há 59.—I enjoin on earth and in heaven to study the Honwar.

The Parsee religion is for all, and not for any particular nation or people.

"Há 46.—May all men and women of the world become my followers, and become acquainted with thy exalted religion. Whoever accepts Zurthost's religion, praises it, and meditates on it, and studies it much, to him God gives a place in the other world; and in this world Bahaman (good conscience) gives him exaltation."

The Parsee religion contains no propitiating of the devil. There is not a single reference to the thoughts, or words, or deeds of evil spirits, without wishing destruction or reformation to them.

"Há 1.—I learn the Zurthosti religion, the worship of God, which is different to that of the Dews (the evil spirits), and is like the justice of God.

Há 8.—May the wicked and the evil-doers be disappointed, and be swept away from the creation of the holy Creator.

Há 12.—I am of the religion of the worship of God, I praise that religion and declare it before the wicked, and praise it with good conscience, and virtuous words, and virtuous deeds.

Há 44.—O Hormuzd, why may not these sinners become virtuous ?

Há 33.—The wicked are punished according to their thoughts, words, and deeds. Better it be that they be introduced to a taste of learning. O Hormuzd, give them a desire for wisdom, that they may become promoters of holiness."

The Parsees are called by others, "Fire Worshippers," and they defend themselves by saying that they do not worship the fire, but regard it and other great natural phenomena and objects as emblems of the divine power. To me it appears that the imputation, on the one hand, is wrong, and the defence, on the other hand, a little overshot. Though the Parsee "remembers, praises, loves, or regards holy," whatever is beautiful, or wonderful, or harmless, or useful in nature, he never asks from an unintelligent material object, assistance or benefit; he is, therefore, no idolator, or worshipper of matter. On the other hand, when the Parsee addresses his prayers to Hormuzd, or God, he never thinks it at all necessary that he should turn his face to any particular object. He would say, and does say, his "Hormuzd yasht" (prayer to Hormuzd) anywhere whatever without the slightest misgiving. Again, when he addresses the angel of water, or any other but that of fire, he does not stand before the fire. It is only when he addresses the angel of fire that he turns his face to the fire. In short, in addressing any particular angel, he turns his face to the object of that angel's guardianship as his emblem. But, in his prayers to Hormuzd, he recognises, or uses, or turns his face to no emblems whatever. Since fire only could be brought within the limits of a temple—any of the grand objects of nature (as the sea, the sun, &c.) being unavailable for this purpose—the temples naturally became the sanctuaries of fire alone, and hence has arisen the mistake of the Parsees being regarded as "Fire Worshippers."

This much is clear in Ha 30—"He who knows God through his works reaches him;" but I do not recollect meeting with any text enjoining a Parsee to turn his face to any particular object as an emblem of God; though he is directed, as in the above text, to rise from Nature to Nature's God.

I do not recollect meeting with a text, that "the Evil Spirit is cöeval with God." In one place, Há 19, all wicked spirits are spoken of as having come into existence after a certain event—"Tell me, O great invisible God, the creator and promoter of all creation, what were thy words before the existence of the heavens, before the waters, * * before the wicked spirits of dull reason, before all creation," &c. Whether these wicked spirits include or not the well-known Harimàn among them, I cannot tell. It is generally supposed that Hormuzd and Harimàn are good and evil principles. I do not think that I have met with any text that supports this theory, as far as Hormuzd is concerned, or in which the good principle is personified. Hormuzd is distinctly "The intelligent living Creator," as far as I can gather, and not a mere personification of the principle of good—a Creator distinct from his creation, either material, moral, intellectual, or spiritual.

In the Yazashné, scarcely once even is Harimàn mentioned. Harimàn, not by this very name, but by the name of Angare Meniús is mentioned in the Vandidad as having, to thwart Hormuzd's good works, produced several evils. This Angare Meniús is rendered in the Gujarati translation, Gana Minó, which, I think, means "the sinning angel," though I am not quite sure of it. I am not at present able to say more about the age, or nature, or meaning of Harimàn; but one thing is clear, that evil will have an end.

"Há 31.—On the day of reckoning all the wicked shall be annihilated."

At the end of the Yazashné is given a list of God's one hundred and one names. Whether all have their authority in the Avestá I cannot say. Among them occur the following—The Almighty, Omniscient, Omnipresent, the Lord of the Universe; without beginning and without end: the beginning of all—the end of all; the greatest, without a like, without rival, &c.

The language of these one hundred and one names, as far as I can judge, from my limited knowledge of the modern Persian, is not Zend.

These extracts are, I think, sufficient to give a general idea of the character and doctrines of the Parsee religion; but it must be remembered that I am not well qualified to speak with any authority on the subject. I have received at third hand the extracts I have given The original Zend is translated into Pehlvi, from the Gujarati translation of which I have given in English. This Gujarati translation is considered rather imperfect, and in several places it is so confused that I have omitted giving some more extracts, simply because they are ambiguous or unintelligible.

I have avoided giving any opinion on, or discussing any of the doctrines. I give the extracts as faithfully as my hurried reading has permitted, leaving it to the reader to draw his own conclusions.

Besides the Yazashné, from which the preceding extracts are given, there are only three or four other books considered by the Parsees as a portion of their original religious books.

But Priestcraft acting upon ignorance has not failed to do its usual work, and has left a legacy of a few books which the Parsee has no reason to be thankful for. Many ceremonies and notions have thus been introduced, and the reformers of the day contend that all those ceremonies and notions that have no authority in the original Zend Avestá ought to be abolished and disavowed. Of course the old orthodox Parsees and the Priests do not like this at all.

When I read the Old Testament many years ago, I was very much struck with parts here and there that almost described the present belief and practices of the Parsees. I have not had time at present to go over the whole book again, but I just turned over its pages to select some of these passages.

I do not know whether the offering of sacrifices is an institution in the Parsee religion—it is not the present practice. Chapter XI of Leviticus concerning what beasts may, and what beasts may not be eaten, what fishes, what fowls, and what creeping things are unclean; the command to wash the clothes in touching the dead carcases of unclean animals, to break the earthen vessel, and consider everything touched as defiled, &c., may be taken as a fair description of what the orthodox Parsees at present believe and observe. This belief being now rather traditional, I do not know whether it goes into the details of the unclean and clean animals, as in verses 13 to 22.

Chapter 12 on the purification of women after child-birth, with the exception of the circumcision, of the three-score and six days for the purification of blood on the birth of a daughter, (which is also 40 days among the Parsees,) and the offerings, is almost all applicable to the Parsees.

Chapter XV on the uncleanliness of men and women in their issues, and cleansing them, with the exception of being unclean until the even, and the offerings, is applicable to the Parsees, and is of present observance among them.

Chapter XVIII on unlawful marriages and lusts is observed by the Parsees; marriage among cousins is recommended, and the Parsees are entirely monogamists. I have an impression that among the Parsees there is an ordinance by which a man of blemish is not allowed to become a ministering priest.

In the Book of Psalms there are passages which strike as similar to the extracts given before from the Yazashné.

At the commencement I gave some account of the present imperfect knowledge of the Parsees about their own religion, I do not however mean to blame them much for it. A handful of persecuted exiles living in a foreign land, surrounded for 1200 years by idolatry, and persecuted at times by religious fanaticism, it is rather a matter of surprise, as with the Jews, that the Parsees have preserved their national type and character, and their original worship. Though they have not altogether escaped contamination, and have adopted many superstitious ceremonies and notions of the Hindoos, they have always recoiled from degenerating to the worship of idols, and have tenaciously clung to the idea that they were worshippers of the invisible Hormuzd. Believing in the existence of Angels and their delegated power to assist and benefit man, the Parsee centres his prayers and his hopes above all, on Hormuzd, the Lord of the Spirits; his whole morality is comprised in three words—pure thought, pure words, and pure deeds; his reward depends upon his fulfilment of these injunctions, and his pardon on the will and mercy of God.

Mr. **Dadabhai** said that no member need feel any delicacy in putting any question to him on the subject of the paper, for he would be very happy to answer them.

Dr. **Ihne** said he had brought with him a French work, by M. Ménant, containing an excellent digest of the Parsee Creed, which, according to it, was briefly as follows:—"There is one God, He is eternal, there was nothing before Him, and all things are by Him. The universe was *truly* created by Him, and is not an emanation from Him, but, since the creation, has been distinct from the Creator. Creation is composed of spirits and matter. Matter is inert, but spirits are capable of morality. The world of spirits is double. Hormuzd is chief of the spirits of good, for eternity. Ahrimán is chief of the spirits of evil, only for time which passes. Both were created by the Eternal, and will endure for the eternity which follows. Souls are all sisters from the beginning, deprived of the body at death, to find it again at the hour of resurrection, then never to be separated from it again—they were eternally pre-existent. The guilty will be punished, the just rewarded—both by God. Punishment will only last as long as the principle of evil (Ahrimán) endures. The Zend authority is from God, and dogmatic. Hormuzd established religion for all mankind, and not for some only. It will be one day preferred by all mankind, and thus be universal both as to time and space." This creed, it is to be observed, is derived from the sacred books, and not from the present belief of the Parsees.

The Rev. C. D. **Ginsburg** said that, having read a German translation of the Zend Avestá, it agreed with the summary Dr. Ihne had read. He remarked that some of their doctrines were also believed by the Jewish sect of Cabbalists. No other people (except the Jews) believed in the resurrection of the body. In the Zend Avestá it was affirmed that both the principles of good and evil were created by the Great Existence, and were not eternally pre-existent, and that every man has both these principles reflected in him.

Mr. Dadabhai said that the creed, as given by Ménant, is derivable from all the extracts he had read, with the exception of the question of the origin of Hormuzd and Ahrimán. That given by M. Ménant is the prevalent theory; but, as far as his reading of the Gujarati translation of the original Zend text went, he had not been able to confirm the story of the creation of Hormuzd and Ahrimán by Time without bounds (Zurwan Akarné), which implied that they were eternal only for *future* time; but he would not speak with confidence on this point.

Mr. Clark observed that in Guizot's edition of *Gibbon's History*, the original principle is called *Time Without Bounds*, and existed from all eternity. The two created principles were both good at first, but Ahrimán became apostate. There were many analogies in the Zend books with the early books of the Bible; for example, an institution is mentioned identical with that of tithes. The ancient Persian religion was one of forms and ceremonies, but that of Zoroaster rather one of morality.

Dr. Collingwood said: We are indebted to the well-known enlightenment and liberality which distinguish the Parsees in general, and my friend Mr. Dadabhai in an especial manner, for the very interesting exposition we have heard of the received doctrines of their religion; and we are, moreover, freely invited to discuss the subject. Mr. Dadabhai stands before us not as a Parsee defending his faith, but simply as a member of this society giving an unvarnished account of what he finds in his sacred books, unencumbered by any theory of his own. But the Zend Avestá also contained much more of an apparently fabulous nature, upon which I would wish to make some remarks. There is a remarkable similarity traceable between all the religions existing before the Christian era, which, I believe, arises from the fact that all those religions, excepting the Jewish, were originally of a purely astronomical origin. Man is in all ages religious, and, as I formerly showed at some length before this society, the heavenly bodies received his first and earliest worship; and the religion of Zaratosht was derived from the prevailing forms of worship. At a very early period the *origin of evil* was a question which agitated mankind. Whence *good* comes, says one, we know—but whence is evil? It cannot come from heaven—for, it is not possible that the same being, whether good or bad, can be the author of both. Hence arose the necessity of supposing two principles always opposing one another. These principles were early associated with physical phenomena. *Light* was good—*darkness* evil; *summer* was the distributor of benefits, which *winter* was always undoing and destroying. But it was the Sun which produced light, and covered the earth with verdure in summer, and his absence which bound it up in winter; and thus this luminary became early personified as the great principle of good, and his struggles and alternate mastery over, and conquest by, the evil principle, were symbolically described in the battles of the gods and giants—of Ouranos and Typhon, of Osiris and Typhon, of Hormuzd and Ahrimân. The very name of Hormuzd signified, according to the best authorities, *the great principle of light;* and the astronomical character of the early Persian fables may be illustrated by one incorporated in the Zend Avestá. Hormuzd made six deities, which represented virtues; whereupon, Ahrimán made six of a malevolent nature. Hormuzd raised himself three times higher than his wont, and decorated the heavens with stars, appointing Sirius sentinel over them. Again, Hormuzd created twenty-four gods, which (says the fable) he enclosed in an egg. Ahrimán did the same, and these broke the first egg, and thus good and evil became intermixed. Now, all this evidently relates to the constellations—the six good deities were symbolical of the six zodiacal signs, between the vernal and autumnal equinoxes, when the sun was in power. The six evil ones were, of course, the six winter signs. Hormuzd raising himself three times his height above the earth, meant his elevation above the spheres of Mars, Jupiter, and Saturn, which would bring him to the pure ether—the region of the stars. The twenty-four gods were the twenty-four northern constellations, six zodiacal and eighteen extra-zodiacal; for, before Hevelius formed constellations from the *stellæ informes* there were but eighteen constellations in either hemisphere. And the twenty-four gods of Ahrimán were, of course, the remaining twenty-four southern or winter constellations. The equinoxes showed the term of duration of power of these great opposing principles; and whether we regard the Persian statues of the bull (Taurus, the vernal equinox) being destroyed by the scorpion (Scorpio, the autumnal equinox), or the fable of Jupiter (the sun of summer) losing his thunderbolt (power, vigour) in winter, as related in the Dionysiac of Nonnus, the meaning is the same. The sun, indeed, was personified with different attributes, according to his position in the zodiac. Thus, the vernal sun was the beardless, youthful Apollo; the autumnal, the bearded, aged Æsculapius, son of Apollo, with a serpent twisted round his staff, or even round himself. This serpent was the great serpent of the heavens, which stretched its length beside the three autumnal constellations of Libra, Scorpio, and Sagittarius, and into whose folds the sun appeared to descend in autumn. Hence the explanation of the well-known mythical Hindoo figures of Vishnu, *conquered* (in autumn), enveloped in the folds of the serpent, and *triumphant* (in spring), with the serpent raised aloft in his arms. And thus we can understand the enigma uttered by the oracle of Apollo at Claros, in Ionia, which said "I am Jupiter Ammon in spring, and black Pluto in winter."

Dr. Ihne said, the astronomical explanation might be very well applicable to the religion which prevailed before Zoroaster as it was to other ancient religions, but that introduced by him was entirely spiritual and moral—that he may have retained some of the institutions of the old faith, but the peculiar characteristic of the Zoroastrian faith was its spirituality and high morality, as must have been seen from the extracts read.

Dr. **Collingwood** replied that he by no means intended to imply that it was not so, and he was glad that Dr. Ihne had given him an opportunity of making himself better understood. The religion of Zoroaster was singularly refined and purified from the more ancient grossness.

The Rev. C. D. **Ginsburg** agreed with Dr. Collingwood in the astronomical nature of the ancient religions.

In answer to questions from various members, Mr. **Dadabhai** said the Parsees were at present, to some extent, fatalists; but this was one of the corruptions which had crept in through their intercourse with the Hindoos. They were monogamous; and their sacred books did not degrade woman below man, though it was only lately that their women had been allowed to mix in society. With regard to the *worship of fire*, which was brought against them, they regarded fire as the purest and best symbol of the Deity, and that one of His works which could be most conveniently isolated and circumscribed; hence, they had sacred fires in the temples, towards which they turned when addressing their prayers—not to it, but to the god of which it was the symbol. The injunction is to turn their face to anything that is glorious, as the sea, the sun, &c. Such is the explanation often given by the Parsees. I have given, however, in the body of the paper what appears to me to be the true state of the case. They would not abuse fire, nor extinguish it unnecessarily, nor use it in a contemptuous manner. Hence, the Parsees do not smoke. Their estimation of all other natural objects, such as water, trees, &c., being quite equal to that for fire, they would not do anything which they consider as abuse or defilement of them; also, they would never spit, nor throw any dirty thing upon them.

The **President**, in conclusion, said that the interesting paper and discussion they had heard more and more convinced him that God was not without witnesses in all countries and in all ages. He called upon the society to give an unanimous vote of thanks to Mr. Dadabhai, which was carried by acclamation.

TWELFTH ORDINARY MEETING.

ROYAL INSTITUTION, 1st April, 1861.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Mr. GEORGE MELLY was elected a member.

The SECRETARY read several letters from scientific societies in London and elsewhere, in which promises were made to send their Proceedings to the Literary and Philosophical Society in future.

Mr. MORTON exhibited various fossils from the neighbourhood of Prescot and St. Helens, consisting of Lepidodendron, Sigillaria, Calamites, Anthrocosia robustus, scales and teeth of fishes, &c.

Dr. COLLINGWOOD read some passages from a private letter from Mr. Darwin, in which that gentleman expressed himself with regard to the theory of natural selection in a manner which could not fail to remove much of the prejuidice and and hostility generally maintained against his views.

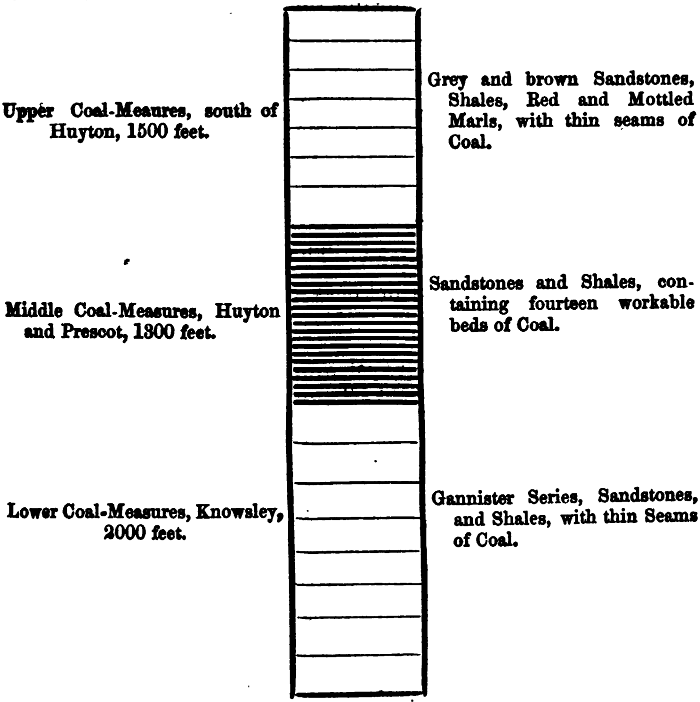
The following paper was then read—

ON THE COAL MEASURES IN THE NEIGHBOURHOOD OF LIVERPOOL, AND THE PROBABILITY OF THEIR EXTENSION BENEATH THE TOWN.

By G. H. MORTON, F.G.S.

The survey of the country around Liverpool having been completed by the Government Geologists, we are in possession of all the materials necessary to present a concise notice of the Coal-measures developed in the district.

A line of section, north and south, with Prescot as the centre, is, perhaps, the most interesting, on account of its showing the whole series of coal strata, and being the nearest workable coal-field. The general succession of the strata is as follows:—


Upper Coal-Measures, south of Huyton, 1500 feet.
Grey and brown Sandstones, Shales, Red and Mottled Marls, with thin seams of Coal.
Middle Coal-Measures, Huyton and Prescot, 1300 feet.
Sandstones and Shales, containing fourteen workable beds of Coal.
Lower Coal-Measures, Knowsley, 2000 feet.
Gannister Series, Sandstones, and Shales, with thin Seams of Coal.

The Coal-seams of Prescot are all represented at St. Helens, but two-thirds of them are known by different names. They are co-ordinate in the "Memoirs of the Geological Survey of Great Britain."* The Coal-beds are more distant from each other at St. Helens than at Prescot; while at Wigan, they are still further expanded by the greater thickness of the intervening measures.

The *Upper Coal-Measures* consist of all the strata between the "Felcroft Coal," and the "New Red Sandstone." This sub-division consists of grey and brown sandstones, shales, and peculiar red and mottled marls, which (at Sutton, to the east of the section), contains casts of Modiola Macadami. There are several thin partings of Coal, one of which may be seen in Burrows' lane, near Sutton. North of Tarbock Hall, the series is overlapped by the "Lower Bunter Formation." No satisfactory section, showing this overlap, is seen, but it is inferred from the two formations being present close together, without any apparent fault. However, at Ashton's Green Colliery, near Sutton, the overlap has been proved by a shaft passing through sixteen yards of the Lower Bunter into the Coal-measures.

The *Middle Coal-Measures.* This is the series in which all the profitable beds occur. The fourteen workable coal-seams have an united thickness of sixty-one feet, and are divided as follows :—

		Ft.	in.
1	Felcroft Coal	7	0
2	Pastures Coal	4	6
3	Discoverer Coal	3	0
4	Yard Mine Coal	3	2
5	Cannel Mine Coal	5	9
6	Higher Bag Coal	6	6
7	Lower Bag Coal	3	6
8	Cheshire Coal	2	3
9	Tenlands Coal	0	0
10	Bastions Coal	4	0
11	Sir John Coal	3	4
12	Prescot Main Coal	10	0
13	Rushey Park Coal	5	0
14	Little Delf Coal	3	0
		61	0

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* The Geology of the Country around Prescot, by Edward Hull, A.B., F.G.S.

The thickness of the Middle Coal Series at Prescot is 1318 feet, including the 61 feet of Coal-seams above two feet thick. At St. Helens, the same sub-division is 1775 feet thick, containing 83 feet 8 inches of Coal; while at Wigan, it is 2188 feet, with 70 feet 7 inches of Coal.

I am not aware that the fossils of the Coal-measures, near Liverpool, have ever been collected together, though there is little doubt they would repay the trouble of a proper search.

In the Prescot district, at Halshead, the shales associated with the Upper Coals consist of hardened bluish mud, crowded with the remains of Calamites and their Spikelets. Sigillaria and Lepidodendron, seem to be common in the lower part of the series. However, as these genera of plants contribute mainly to the formation of Coal, their occurrence is common to all Coal-fields. Impressions of ferns are seldom to be obtained, but fish fragments, scales, teeth, and bone-plates, are common in strata associated with the Rushey Park Coal-seam. They belong to the genera Gyrolepis, Platysomus, and Cœlacanthus. Anthrocosia robustus occurs above the Ravenshead and Rushey Park coals. This shell, formerly considered to be an Unio, is now thought to be a marine, or brackish water species, from having been found lately, associated with Modiola and other marine shells. At Whiston, there is a bed of limestone four feet thick, with Microconchus carbonarius.

The *Lower Coal-Measures*, or "Gannister Series," extends from Huyton Quarry to the north of Knowsley. The Huyton sandstones are the upper beds, while a series of greyish grits, resting upon black shales, at the Stand Quarry, Knowsley Park, are the lowest beds—the deepest strata visible within the same distance of Liverpool.

A bed of Coal, 2 feet thick, has been worked in this series in Knowsley Park, at Hag Delph; but as this was many years ago, little is now known about it. There are at present no openings in the strata, otherwise, marine shells, so common in other localities, would, no doubt be obtainable; Goniatites, Aviculopecten, Spirifer, &c., being characteristic of these strata, as at Pimbo lane, near Wigan.

Sections of the strata, at Huyton Quarry, Thatto Heath, Neston, and other places, show the position of the New Red Sandstone in respect of the underlying Coal formation. In each section, the Trias is thrown down against the edges of the Coal-measures, leading to the conclusion that the Coal strata are continued beneath the New Red Sandstone. From these and many other interesting sections in the neighbourhood, the following conclusions have been drawn:—

1st. That faults usually separate the New Red Sandstone from the Coal-measures in the district around Liverpool; the exceptions being overlaps.

2nd. That the Coal-measures were denuded *principally* after the deposition of the Trias.

3rd. That the middle productive Coal-measures underlie the New Red Sandstone between the River Dee and Huyton; and that coal would, probably, be reached at moderate depths, on both sides of the Mersey, at the up-cast side of faults.

In addition to the favourable spots shown in a section published in 1856,* Eastham and the Dingle are places where collieries will be worked at no very distant period.

The importance of adding to our carboniferous deposits is very obvious. The consumption of Coal in Great Britain amounts to 67,000,000 tons per annum; but even this large quantity will probably be insufficient for the increasing supply of future years. Coal-mining is not usually carried on so low down as 2,000 feet. If mining was limited to that depth, some of us might live to see an advance in the price of Coal. A work just published by Mr. Hull, "On the Coalfields of Great Britain," gives a great deal of useful information on a subject upon which he is, perhaps, better able to give an opinion than any other person in this country. He gives a very favourable opinion upon the possibility of obtaining Coal to the depth of 4,000 feet, and then endeavours to show, at the present rate of consumption, based on calculations of quantity to 4,000 feet below the surface, *that there is enough of coal to last for* 1,000 *years*. In addition to the vast increase of supply to be obtained from deep mining, Coal will, before long, be obtained by boring through the Triassic and Permian rocks in situations many miles from the out-crops of any carboniferous strata. In the midland counties shafts penetrate through the lias and red marl to productive beds of Coal. About Manchester the Permian is passed through in several shafts. These places are, however, all upon the borders of Coalfields, the borings passing through overlaps of the superincumbent strata.

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* Proceedings of the Literary and Philosophical Society—Session, 1855-56.

A paper was also read—

ON THE RECENT CEPHALOPODA.

By THOMAS J. MOORE, Corr. Mem. Z. S.

(Curator of the Public Museum.)

The object of this paper was to bring before the notice of the Society in a connected form the materials accumulated for the illustration of this division of the Mollusca in the Typical or Educational Collection of the Free Public Museum. The characters of all the genera were briefly enumerated, and examples of the following exhibited:—Octopus, Eledone, Argonauta, Sepiola, Rossia, Sepia, Spirula, Loligo, Sepioteuthis, Onychoteuthis, Ommastrephes, and Nautilus. Among the more interesting specimens were the following:—A large Octopus vulgaris, taken in the Albert Dock, Liverpool, in 1854. This specimen lived twenty-four hours in confinement, and whenever the strong light of a moderator lamp was thrown upon it during the night, that portion of the animal exposed to the light was immediately suffused with a deep tint of Sepia.*

Second. A specimen of Rossia (macrosoma?), captured at New Brighton in 1857. This genus, of rare occurrence in any part of the British coast, had not previously been detected in the estuary of the Mersey.

Third. The "pen" of a gigantic Squid. The animal from which this was taken was captured by Captain Mortimer, of the American ship "Florida," about 200 miles N. W. of Bermuda. It was nearly nine feet in length—was estimated to weigh 3½ cwt., and required six men to hoist it into the vessel.

From the fact of this Squid having been provided with hooks on the arms, as distinctly stated by Captain Mortimer, it, in all probability, belonged to the genus Onychotenthis. The pen itself measures 3 feet 9 inches. The 'beak' of the same creature is in the collection of Mr. Francis Archer.

It was remarked by Dr. COLLINGWOOD that the Cephalopoda are extremely well-illustrated upon our own shores; all the British genera, excepting only Ommastrephes, being found on the Liverpool coast.

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* The above specimen is the one referred to in Proceedings, 1859-60, p. 32.

THIRTEENTH ORDINARY MEETING.

ROYAL INSTITUTION, 15th April, 1861.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Mr. **JAMES BLAKE** was elected a member.

Among other donations laid upon the table, the **PRESIDENT** called particular attention to a set of the volumes of Proceedings of the Royal Society, from A.D. 1800 to the present time, and announced that this valuable acquisition was due to the activity of the Honorary Secretary, who was doing much to improve the society's library.

A communication from the Council was made to the society, to the effect that it was recommended that the members should dine together, at some suitable time and place, during the recess. Childwall, and the latter part of May, were mentioned, and the proposal met with the cordial approval of those present. A committee was appointed to make the necessary arrangements.*

Dr. **COLLINGWOOD** exhibited a cuttle of the genus Rossia, taken by Mr. A. Higginson, at New Brighton, some years ago. It was but recently that this rare animal was known as an inhabitant of our shores, and now two specimens have been brought forward, both from New Brighton, and probably of different species.

The following paper was then read—

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* This dinner took place at Childwall Abbey Hotel, on Monday, 13th May. The beauty of the day enhanced the success of the gathering, which was of the most agreeable nature. Covers were laid for forty-five gentlemen, being as many as the room would comfortably accommodate; and the guests, having first

CONTRIBUTIONS TO BRITISH ORNITHOLOGY;— THE NOTES OF BIRDS.

By CUTHBERT COLLINGWOOD, M.A., F.L.S., &c.

The subject of the present paper, if it possess no other merit, is, at least, appropriate to the season, since our woods already resound with the songs of our indigenous birds, while the first instalment of the more musical band of foreign visitors has already appeared among us.

I hardly think, however, that the subject needs any defence, inasmuch as it is one of considerable interest to the general naturalist, and, to the ornithologist, *essential*. It is, moreover, a subject which, in my opinion, is singularly neglected. True, that in most ornithological works, a few pages are devoted to the notes of birds; but, as far as my experience goes, the cursory remarks found in these works are of a very general nature, and, in most cases, mere repetitions, copied from one author into another. In scarcely any work that I am acquainted with, is the subject fully entered into as a matter of personal

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assembled on the bowling-green, sat down to dinner at four o'clock. The chair was taken by the Rev. H. H. Higgins, M.A., President, who was supported on his right by the Worshipful the Mayor (S. R. Graves, Esq.), and, on his left, by Mr. J. A. Picton, F.S.A., Vice-President. The vice-chair was occupied by Dr. Edwards, senior Vice-President; and among the company were Dr. Ihne, Vice-President, Mr. Byerley, Treasurer, Dr. Collingwood, Hon. Sec., Drs. Nevins and Walker, Revds. Dr. Hume, Macnaught, Hindley, and Robberds, Messrs. Clark, Redish, &c. A very creditable repast was served, and the cloth having been removed, and the usual loyal toasts disposed of, the President proposed, "The town and trade of Liverpool," with the health of his Worship the Mayor, to which that gentleman responded in the graceful manner which is natural to him. His Worship then proposed, "Success to the Literary and Philosophical Society," to which the President responded. "The kindred Societies," were the subject of a toast proposed by the Vice-chair, and responded to by Mr. Clark. Dr. Ihne proposed, "The Free Public Library and Museum," with the health of Mr. Picton, who responded. The "Friends and Visitors" were proposed by Mr. Redish, and acknowledged by Mr. Cummins. "The Honorary Secretary," proposed by the Vice-chair, and responded to with musical honours, was acknowledged by Dr. Collingwood; and after the toast of "The Ladies," the party broke up—all highly pleased with the success of the entertainment, which partook rather of a humorous and amusing, than of a formal and unbending, character.

knowledge, and when descriptions *are* given of the notes of particular birds, they are most frequently of so diffuse and general a character as to have but little practical value.* Doubtless, there are many who have a profound acquaintance with the voices of birds, even approaching that of the Grand Vizier, in the *Spectator*, who, indeed, is not so fabulous a personage as at first sight he would appear to be; but these persons do not give the benefit of their experience for the guidance of others, and the subject is so purely one of experience, that it is only those who *can* give useful information upon it.

The language of birds is, then, only to be learned in the woods and fields—only to be taught by Nature herself; at the same time, however, the hints of experience should not be neglected, for although it is useless to remain *satisfied* with these, and suppose *them* sufficient in themselves for a knowledge of the subject, still they may greatly assist the student of ornithology in his endeavours to identify the various birds by their multifarious notes; and let no one think that such a study is altogether useless. I have before said, that for the ornithologist, properly so called—not the ornithologist who is content with books and plates, however elegant, but for him who goes out into the native haunts of birds, and enquires for knowledge at the fountain-head—for such an one, a knowledge of bird-language is indispensable, and of constant application. It is a *specific* character which thrusts itself upon the attention, and appeals to the ear resistlessly. By means of it, in our own country, the arrival of foreign visitants and of migratory birds is readily noted, and a clue is obtained to the habits and existing conditions of indigenous birds; while in foreign countries, a careful attention to the voices of birds not only would greatly facilitate the discovery of new species, but the detection of European birds, or, indeed, the negative knowledge—the absolute certainty that such a bird is not the European species—would assist greatly in elucidating the phenomena of migration.

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* There is much interesting information in Barrington's well-known article (Phil. Trans., 1773); also in Bolton's "Harmonia ruralis;" Gardiner's "Music of Nature," &c., but these are of old date, and Kircher's quaint remarks in "Musurgia" are more curious than practical. There are many interesting notices scattered through Loudon's Magazine of Natural History; and the general reader will find much information in the "Domestic Habits of Birds" (Library of Entertaining Knowledge); and also in an article on the songs of birds by the late P. B. Duncan, in the "Literary Conglomerate."

I have called it language, for such indeed it is, which, like its analogue, human speech, has undergone a Babel-like confusion; nevertheless, each species comprehends the notes uttered by its own, but these notes do not influence another species. Indeed, the analogy may be carried even further. The human voice utters certain sounds which, by a national freemasonry, are understood by all alike, however different their tongue—so with birds, there are certain sounds which are understood by all birds in common—the sounds, that is, which indicate the near approach of common danger. Besides all this, it must ever be borne in mind that birds are, next to man, most gifted with the power of expressing by sounds the feelings and impulses which arise under the various conditions and circumstances in which they are successively placed. Although, however, I purpose, in the present paper, to address myself more particularly to the warble, or love-song, of birds, it must not be imagined that they have no other vocal gifts. The male, the female, and the young, all have their peculiar notes, a knowledge of which may be of service, as it cannot fail to be of interest, to the ornithologist. The male has his defiant note, or battle-cry—his loud outcry when danger approaches—the call he possesses in common with the female, by means of which they are constantly informed of each other's whereabouts—the soft note which he employs when feeding the sitting hen, as well as the more or less brilliant serenade with which he, perhaps, banishes her *ennui;* the female has her complacent chuckle, when surrounded by her little brood—the notes of invitation when food is forthcoming—of alarm on the approach of danger; while the young have their infantine squeal,—their strengthening notes before being fully fledged,—and their gradually perfecting recording notes thereafter. All these are distinct from one another, as well as different in each species of bird. All these notes, therefore, if known, give certain indications to the listener—all assist in the investigation of habits; and a person armed with such knowledge is in a position to study their habits immensely superior to that of one who is ignorant of them. The value of such knowledge may be better inferred from the fact mentioned by a writer in the Quarterly Review (vol. xviii., 1817), who states, on personal authority, that one individual, who had passed much of his time, in boyhood, alone, in lonely situations, had, by close attention, acquired such a knowledge of this language, that from the song of the parents, he knew where the nests were situated, whether they contained eggs, or whether the brood was hatched, knowing even the number of young birds, and their eggs before he saw them. Incredible as this may appear, we can readily imagine its possibility.

I need not dwell longer upon the uses of this kind of knowledge which I have sufficiently indicated. As for its *pleasures*, no one but those who have tried them can by any means appreciate them; not only that the voices of birds give a general delight which the educated and uneducated can alike appreciate, but I will venture to say, without fear of contradiction, that a knowledge of the meaning of each note as it strikes upon the ear—the power of identifying each song with the particular species that utters it, affords a delight and recreation—keeps the mind constantly employed—and relieves the tedium of many an otherwise dreary, solitary walk, substituting for *ennui* and weariness, a pleasure only known to the true ornithologist.

But the subject is so extensive, that I shall in vain endeavour to compress its principal salient points into the compass of a single paper; and must pass over some of them rather hastily.

For this reason, I shall not dwell long upon the anatomy of the organs of voice, which may be found described in many places. The trachea and its appendages are the organs which produce these various sounds; but the trachea differs from that of man by possessing a double larynx, and two rimæ glottidis, the upper of which is at the upper end of the trachea, and is not furnished with an epiglottis. The lower or bronchial larynx is situated at the bifurcation of the trachea, and contains also a *rima glottidis*, formed by tense membranes, which may be compared in many cases (particularly among aquatic birds) to the *reed* at the mouth of musical instruments. These membranes, susceptible of various tensions and vibrations, constitute a true glottis, provided with everything necessary to produce sound. This is an abstract of the results arrived at by the dissections of Blumenbach, and by Cuvier, detailed in the *Journal de Physique* (I. 142); and his experiments prove that the voices of birds are produced in fact by this *lower* glottis at the base of the trachea; while the upper glottis contracts and widens for the modification of the sounds, and the muscles, along the trachea, from time to time, vary the length of that instrument, producing the same effect as long or short organ pipes. The trachea thus becomes an instrument to conduct *sound*, instead of a mere tube to conduct *air* from and to the lungs. Cuvier further adds that he found this organ absent in *one bird only* of those he dissected, viz., the King of the Vultures (Vultur papa). The organs of voice of birds, therefore, most resemble French horns in their general structure.

Some doubt appears to rest upon the real object of the long circumvoluted trachea in certain Natatores, but I imagine that this singularly developed organ has other uses than for singing or screaming. In singing birds, generally, it is short, and lengthens with age. But I think old Kircher was probably right in connecting these circuitous tracheæ and their osseous chambers or ampullæ, so common in the Anatidæ, with their aquatic habits, supposing them to be reservoirs of air for the use of the bird when feeding under water.

The question now comes—since every bird, as I have already said, possesses some kind of voice, and more or less notes, but all kinds do not sing—What, then, is *singing*, and how defined? The most original writer upon the singing of birds is certainly the Hon. Daines Barrington, the well-known correspondent of Gilbert White, an accomplished naturalist, to whom I shall have again to refer. His experiments, which are the groundwork of all the subsequent remarks on this subject, are detailed in a paper *On the singing of birds,* read before the Royal Society, and published in the sixty-third vol. of Phil. Trans. There are many curious observations in this paper well worthy attention, though there is much besides which must be referred to the eccentricity of its author. In this paper, he defines song to be, "A succession of three or more different notes, which are continued without interruption, during the same interval with a musical bar of four crochets in an adagio movement, or whilst a pendulum swings four seconds." With the former part of this definition, I perfectly agree. I certainly do not consider a bird in the light of a *song-bird* unless he has at least three distinct notes. Less than these would be a mere *call;* and even three notes sometimes appear to be uttered by some birds which have no claim to the title of singing-birds; but such birds constantly *repeat* their limited notes with an execution anything but musical, as, for instance, the domestic cock; while the tits, for example, have but two or three notes, which, however, they vary infinitely, and give with great sprightliness and effect. But I think Barrington errs in favour of a prejudice which I shall speak of later, when he says that a true song must last at least four seconds; for that would exclude such birds as the hedge-sparrow and chaffinch, whose songs I have frequently timed, and found them barely to extend through the stated period, although a great number of notes are uttered, and those, too, given with considerable execution. I am not aware of Barrington's reason for assigning four seconds as the smallest limit; but I fancy it is because of his musical ideas of the notes of birds, as though they should sing in *common time*. But I know no other reason, beyond an arbitrary one, why three seconds should not be the limit, or even less. For a bird will crowd a great many notes into a very brief space, as my own observation has shewn me. Thus, I have counted twenty notes in the song of a hedge-sparrow which did not exceed two seconds in duration, though the ordinary length of its song is nearer four seconds. But the gold-crest and creeper, which generally utter twelve to fifteen notes, scarcely ever come up to the limit of three seconds.

All birds have some *language*, emphatically speaking, by means of which they may communicate with one another of the same species; and there are even some notes which every species appears to understand in common—an universal language, comprehensible by all. The amatory warble, or song, however, is confined to comparatively few; but of all the various notes of birds, *that*, perhaps, is the least like language; for, if a bird utters his song at all, it is performed with more or less of liveliness and cheerfulness; whatever may be the external circumstances, it appears to indicate happiness; but those birds which possess far inferior powers of voice can, nevertheless, modulate it, and give it character and meaning to a truly wonderful extent. The single *caw* of a rook can be varied infinitely, so as to express every possible emotion; and a person who listens for the first time, will be astonished at the variety which he will discover in the meaning of a single note. This gift, which may thus be compared to *speech*, is universal among birds, whereas, song is the attribute of only a small portion of the feathered creation, and these are all included within the single order of Insessores, which, however, includes a vast assembly of birds. An exceptional instance certainly occurs in the case of a Raptorial bird, viz., the Falco musicus (Daudin) or Fauçon chanteur; but these Raptorial birds are in general by no means melodious. The eagles and falcons utter a shrill or wailing scream—the vultures are capable of nothing beyond a "gruff caw," and the owls give forth a melancholy hoot or shriek which may well scare a benighted traveller.

The Scansorial birds, in general, utter the most hideous shrieks, and the shrillest and most discordant noises, though, at the same time, among these are found those birds which, owing to their docility, and peculiar structure of tongue, &c., are most capable of uttering articulate sounds. The Gallinaceous birds have generally the most powerful voice, though unmelodious and unmusical in the extreme, as the peacock and Guinea fowl. The Waders can do nought but scream discordantly, though in this accomplishment they are certainly outdone by the Natatory, or swimming birds.

But, with the single exception before referred to, all singing-birds, properly so-called, are to be found in the ranks of the Insessorial, or perching birds; and among *these*, but a very small minority are so gifted. Indeed, with one or two exceptions, only five families out of twenty-five, into which the Insessores have been divided, are singing birds. These families are the following—Of the tribe Dentirostres, the Merulidæ (thrushes), Sylviadæ (warblers), and such Ampelidæ (chatterers) as compose the genera Vireo and Pachycephala. The other two families belong to the tribe Conirostres, and are the Fringillidæ (finches), and Sturnidæ (starlings). Striking exceptions occur in the case of the swallow, a Fissirostral, and the wren, a Scansorial, with which last also the creeper (Certhia) claims to be associated.

Perhaps there is no question relating to birds which has been more frequently debated than the *reason* of their song. It has long been a generally received opinion, for which De Buffon is quoted as an authority, that the song of birds is wholly and solely intended as a solace to the female during the tedious period of incubation. This, it has been urged, is the only object of their melody, as the poet of Nature, generally truer to Nature than to prejudice, expresses it (Spring, 614)—

> " 'Tis *love* creates their melody, and all
> This waste of music is the voice of love."

Now, it is certain that the time when birds, in their natural state, are in most perfect song, is just that period when the business of pairing, and nidification, and incubation, is going on; but although birds sing strongest then, it must be clear that that is not the only time when their voices are heard. After the brood is hatched it is true that most birds cease singing, for they have more serious business to attend to, viz., the feeding of young ravenous creatures, which require a fresh supply every two or three minutes, or even oftener, during the entire day. As the parent bird usually can only carry sufficient for one young one at a time, and there are generally four or five of them, the male and female are equally busy in the search for grubs or seeds, and no time is left for the cock to sit upon a spray and warble his ditty. But in the autumn, when all nidification and incubation is concluded, the song reappears in many indigenous birds, and even in several visitors. Of those that remain, some have already winged their way south, doubtless to expend their music upon some boundless and uninhabited solitude. Again, if song is such a consolation and solace to the sitting hen, why is it confined to so small a minority of the feathered tribes? Why should so many be deprived of that solace? These questions must be answered by the upholders of such a theory. Caged birds, when abundantly fed, and kept warm and clean, sing all the year round—except during the autumnal moult—become, in fact, perennial, instead of annual songsters; and Swainson says that "in more genial climates, and especially between the tropics, the forests resound all the year round with the notes of birds, both before and after incubation;" * and, indeed, we see a similar phenomenon occur even in this northern latitude; not only do many birds resume their songs in autumn, but some, for instance, the robin and the wren, sing the whole year, with the exception of the moulting season, even during frost and snow. Thus, in 1854, I missed the red-breast's voice only three weeks in the whole twelve months. I have heard him in frost and snow, again and again; and on one of the most arctic days we have experienced in this climate (occurring in January), I have heard the wren and the bunting singing merrily. Now, as nidification only takes place in spring and summer—this autumnal recommencement, and this winter display of song, shew pretty clearly that it is not dependent *only* on amorous feelings; nor is it intended *only* as an address to the female. What, then, is the object of song? It may be a complex one, and this question, perhaps, will best be answered by a relation of the conditions under which birds sing. These are truly numerous and diverse. Col. Montagu, indeed, asserts that whenever, and at whatever time of the year birds sing, their testes will be found enlarged; but to prove this satisfactorily, would, I imagine, require larger data than is likely to have fallen to the lot of that accurate observer.

One of the chief conditions under which birds sing, next to those we have just referred to, is *a spirit of rivalry.* Thus, Barrington, in his paper on the singing of birds, says that the bird-catchers lay considerable wagers whose call-bird will jerk the longest, as that determines the superiority. "They place them opposite to each other by an inch of candle, and the bird who jerks the oftenest before the candle is burnt out wins the wager. We have known a linnet, on such a trial, persevere in its emulation till it swooned from its perch." Mr. Sweet, in his "British Warblers," gives instances of birds falling dead from their perch when trying to outrival some other bird confined with it in the aviary.

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* I am informed, however, by Mr. Charles Waterton that, in the South American forests, there are periodical intervals of silence, corresponding with the rainy season.

Another condition under which birds sing is in the excitement of an unusual noise. Thus, a caged bird will sing when a noise is made, whether harmonious or discordant; and I have heard a nightingale sing continuously in a bush within half-a-dozen yards of the Great Western Railway, while a long and heavy goods train has been thundering past at dead of night.

Some birds sing immediately that they are disturbed. Instead of being frightened and silent, a sudden disturbance will set them singing. This is especially the case with the nightingale, and the sedge-warbler, both nocturnal birds; and many a time I have discovered the presence of the latter, when silent, by throwing a stone into the willow-patch where I supposed him to be concealed, and he has forthwith commenced his lively song.

No external circumstance of weather will prevent a bird from indulging in song. The most miserable degree of cold or wet, or both, only seems to animate him. Thus, I have frequently remarked in early morning, when the singing of the birds has induced me to expect bright weather, on looking forth, the utter wretchedness and cheerlessness of the scene has disappointed and surprised me. Indeed, some birds seem to rejoice in these sorts of miseries. The missel-thrush is well known under the name of *storm cock,* from his habit of singing loudest when the wind and storm are highest; and I have remarked the wild warble of the blackbird to be exultant all through a sharp storm of thunder and lightning.

Again, birds have been known to sing under circumstances which, according to our pre-conceived notions would be discouraging in the extreme, and little incentive to any expression of love or joy. Birds which have been taken by the bird-catchers often sing the instant they are trapped. Barrington says a nightingale was brought to him which had only been a few hours in the cage, when it burst out into a roar of song; and even more striking instances have been related.

Amongst birds which have no song, properly so-called, some use their notes in a peculiar and characteristic manner. Thus, pheasants always crow when they go to roost, as though to give a premium for poaching. Swifts are very clamourous just before they retire for the night; and the same thing must have been observed by every one in relation to sparrows and rooks. The loud cries, too, of birds, especially aquatic birds, which travel overland during the darkness of the night, are evidently uttered for the purpose of keeping together the members of the travelling party; while, in like manner, birds which have paired, or which have a brood capable of joining them in their flight from bush to bush, constantly utter a complacent chirp, which serves as a notice of their proximity, and keeps the whole party together.

A very interesting question in connexion with the singing of birds is, whether their song is innate or acquired. A great deal has been written upon this subject, and the Hon. Daines Barrington made several patient experiments in order to satisfy himself upon it; the result of his observations being to convince himself that "notes in birds are no more innate than language is in man;" but, without entering into a critical examination of all his data, I must confess that I see cogent reasons for dissenting from his conclusions. Regarding, as I do, the song as a specific character of a bird, and variable, like other specific characters, within definite limits, it appears to me to be contrary both to analogy and experience to imagine that it depends upon any accidental circumstance whether a bird shall have the song of its own species, or that of some other which it may happen to have heard. If the notes of birds were simply *acquired*—if *teaching* were necessary—it could hardly be otherwise than that some birds, deprived of their parents at an early period of their existence, should grow up either with no notes at all, or with the notes of some other species which happened to be in nearest proximity. But are there any instances on record of birds in the wild state using notes other than those of their own species? I know of not a single one; nor, indeed, does Barrington pretend that he ever met with, or heard of, such an instance. It is true that, in confinement, birds may be taught to pipe the notes of another species; but this only proves that they possess powers of imitation, which, added to a docility of disposition, render them easy of education. The song of a canary which has been educated under a titlark, for instance, is, in this point of view, strictly analagous to the pipe of a bulfinch which has been taught to whistle "God save the Queen." Both are examples of education only.

It may even be conceded that some birds in their natural condition, possess imitative faculties which render them capable of mocking other birds; but such birds either do not confine their mimicry to the notes of one species (as the American mocking bird) or they only give here and there a snatch from the song of another bird, mingling it up with the unmistakeable notes of their own species. Such birds (which White designates *polyglots*) may be indeed innocent of even that amount of imitation, and probably are so, the resemblance to certain strains of other birds being perfectly natural. But the constancy of all birds in a state of nature to the pipe of their own species—a constancy which no observed fact has ever been brought forward to shake—is, to my mind, irrefragible proof that those notes are, if not absolutely innate, at all events so strongly impressed on the bird's nature, that, under ordinary and normal conditions, it would attempt no others. All the instances of birds singing other notes than those of their own species are related of *caged* birds, and Barrington admits that, under these circumstances, it is "very uncertain what notes the nestlings will most attend to, and *often their song is a mixture.*" In a natural state, on the contrary, it is very *certain* what notes a bird will sing; as Barrington expresses it in the next paragraph, "in a wild state, they adhere steadily to the same song, insomuch that it is well known, before the bird is heard, what notes you are to expect from him." *

Having thus touched upon the questions, how, when, and what birds sing, I will now dismiss these general considerations, and in what follows, shall devote more particular attention to our British birds of song. It is generally admitted by those who have paid attention to ornithology, and who have heard the vocal exhibition of foreign countries, that we have, in our own island, a chorus of song-birds second to none. The plumage of our songsters is in general nothing to boast of, but the sweetness and variety of their tones carry off the palm. Indeed, song and plumage, as a general rule, are inversely proportioned to one another, and the gayest birds have often the vilest voices. According to the restricted definition of song given above, we may reckon as many as thirty-six singing birds, of which twenty-three are indigenous, and thirteen, summer visitors.* The notes of these are each characteristic, and although space will not allow me to describe them individually, I shall, by arranging them in a tabular form, endeavour to convey some idea of their affinities and mutual relations.

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* Barrington also admits elsewhere, "that the bird called a *Twite* by the bird-catchers commonly flies with the Linnets, yet those two species of birds never learn each other's notes, which always continue totally different."

Barrington has given in a note, a table which professed to shew the comparative merit of our song birds; the idea of which, he tells us, he borrowed from Mons. de Piles, in his "Cours de Peinture." This table, although well-known, I shall, for the sake of illustration and comparison, introduce in this place:—

DAINES BARRINGTON'S TABLE OF THE COMPARATIVE MERIT OF BRITISH SINGING BIRDS.

20, the Point of Absolute Perfection.	Mellowness of Tone.	Sprightly Notes.	Plaintive Notes.	Compass.	Execution.
Nightingale	19	14	19	19	19
Skylark	4	19	4	18	18
Woodlark	18	4	17	12	8
Titlark	12	12	12	12	12
Linnet	12	16	12	16	18
Goldfinch	4	19	4	12	12
Chaffinch	4	12	4	8	8
Greenfinch	4	4	4	4	6
Hedgesparrow	6	0	6	4	4
Aberdavine (or Siskin)	2	4	0	4	4
Redpoll	0	4	0	4	4
Thrush	4	4	4	4	4
Blackbird	4	4	0	2	2
Robin	6	16	12	12	12
Wren	0	12	0	4	4
Reedsparrow	0	4	0	2	2
Black-cap, or the Norfolk Mock Nightingale	14	12	12	14	14

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* There are, in addition to these, nine or ten other birds which enjoy the reputation of singing birds, but as these only visit us in the *winter*, they are not often heard in this country. Such are the Siskin, Redpoll, Brambling, Grey Wagtail, &c. If to these be added the Tits (Parus,) which some may consider as worthy of admission into the list, we have then about 50 songsters in our Avi-fauna.

There are few, I fancy, who will be disposed to agree in this estimate of the powers of our feathered favourites, and although the table is frequently cited, it is always done under protest, and rather as a curiosity than for any intrinsic merit. For my own part, I have often wondered that so acute an observer, and ardent an admirer of our song-birds as the Hon. Daines Barrington undoubtedly was—one, too, who was evidently possessed of a musical ear—should have so far erred in his estimate; and it is not easy to discover the principle which he employed in the construction of the foregoing table. He says, indeed, "I shall not be surprised, however, if many may disagree with me about particular birds," but, still, I cannot believe that the subject is so much a matter of caprice as this would indicate, or as the table would appear to prove. I think it may be partly owing to the fact that Barrington was accustomed to judge of birds, not in their wild state, but as "cribbed, and cabined, and confined," having received more or less *instruction*, and more or less of what he would have called *opportunities of improvement*. In these respects, he was an artificial ornithologist, one who delighted not in what he called "the *rank* song of a nightingale in spring," but made all his observations upon caged birds, which had been duly educated by art, and sung, in spite of nature, all the year round. If we compare, in his table, the voices of the Thrush and Robin, or those of the Blackbird and Greenfinch, it will be at once apparent that it is largely defective, and except in its form, solely a curiosity.

Mr. Barrington does not appear to have attributed perfection to any bird, even though nature and art should combine to attain it; in which I think he errs. He has given 20 as the point of perfection, but no bird is so gifted as to reach it, not even his favourite Nightingale, which "sings with superior judgment and taste," and again, with "a most astonishing effect, which eludes all verbal description," &c. Surely, in the works of Nature, perfection is somewhere reached, and the

Teacher of our woodland vocalists would never pause at 19 in his masterpiece, when 20 was attainable. Further, Mr. Barrington seems to have had a partiality for particular numbers, and an analysis of his table shews, that out of 76 numerals employed, the number 4 occurs 29 times, and the number 12 seventeen times; these two numbers thus comprising together 46 out of 76, of which the table is composed.

I have often been surprised that this table, formed by Barrington in 1773, although it has attracted much attention, has never been imitated with a view to improvement and perfection. Such an improved table would naturally be a source of much amusement in its formation, as well as of some interest to those well acquainted with the varied voices of British birds, in the comparison of its results with their own ideas and feelings. I venture therefore to offer the following, not as a perfected, but as a somewhat improved scheme upon that of Barrington's, founding its claim for improvement upon the following considerations:—

In the first place, the numbers are derived from a careful observation of the birds in their native haunts in spring, when their powers of song are in the most perfect natural condition. Secondly, I have introduced a considerably larger number of birds than those referred to by Barrington, in fact perhaps all those which have any claim, when judged by our definition to be regarded as British singing birds, and numbering 36. Thirdly, I have made 24 the point of perfection, instead of 20; because I thought that by so doing, the facilities for comparison among a so much greater number of birds would be proportionately increased, without incurring any loss in the general plan. Fourthly, I have admitted that the point of perfection is attained by at least some one bird in each of the qualities, considering the bird against which 24 is marked as the type of that quality. Fifthly, I have superadded to the five qualities mentioned by Barrington, a sixth, viz., power or strength of voice, as decided by the distance at which it can be heard; in my humble opinion, a very essential element of a fair judgment in the consideration of tones as sonorous as those of the Missel-Thrush, and again as weak and feeble as those of the Goldcrest. And, lastly, the whole has been framed with a due regard to a strict comparison between birds most allied to each other in the nature and quality of their notes, by which any great discrepancy is necessarily avoided.

TABLE OF THE COMPARATIVE MERITS OF BRITISH SONG BIRDS.

(IMPROVED AND CORRECTED.)

No.	24, the Point of Perfection.	Mellowness of Tone.	Sprightliness.	Plaintiveness.	Compass.	Execution.	Strength of Voice.
1	Dipper	10	18	6	18	16	20
2	Missel Thrush	8	2	12	5	4	24
3	Song Thrush	17	14	8	16	14	20
4	Blackbird	24	6	14	16	10	18
5	Hedgesparrow	6	8	12	18	9	8
6	Redbreast	10	15	20	10	9	12
7	Redstart	8	12	10	12	12	8
8	Stonechat	6	10	7	9	9	7
9	Whinchat	8	12	8	10	12	10
10	Wheatear	6	14	6	10	10	10
11	Sedge Warbler	4	15	10	14	16	12
12	Reed Warbler	10	16	10	18	18	14
13	Nightingale	22	14	24	24	24	17
14	Blackcap	22	18	14	20	22	16
15	Garden Warbler	20	15	16	18	17	17
16	Whitethroat	6	16	10	15	16	12
17	Lesser Whitethroat	6	14	8	10	12	10
18	Willow Warbler	10	16	14	10	8	14
19	Goldcrest	0	11	6	8	6	4
20	Pied Wagtail	9	14	10	12	10	10
21	Tree-pipit	6	12	14	16	14	16
22	Meadow-pipit	8	14	15	17	15	16
23	Skylark	6	20	4	18	18	23
24	Woodlark	20	16	20	12	18	15
25	Black-headed Bunting	4	8	4	6	6	10
26	Cirl Bunting	2	7	6	5	6	14
27	Chaffinch	14	16	12	13	17	15
28	Tree-sparrow	0	4	2	5	5	12
29	Greenfinch	10	12	8	10	14	10
30	Goldfinch	11	14	10	14	17	16
31	Linnet	15	12	15	12	16	9
32	Bullfinch	7	5	6	8	8	7
33	Starling	8	12	14	16	12	6
34	Creeper	0	9	5	6	5	4
35	Wren	0	24	0	12	16	16
36	Swallow	12	18	16	16	17	10

An analysis of the foregoing table shews that the Blackbird has been selected as the type of the quality of mellowness of voice, the Wren for sprightliness, and the Nightingale for plaintiveness—the last, of course, carrying off the palm in compass and execution. For strength of voice the Merulidæ are all remarkable; the loudest, perhaps, being the Missel Thrush, though the Lark nearly approaches him in this particular.

In this table the birds are arranged according to their *families*, but the sum-total of the figures appended to each bird will give the following *scale of superiority* in song:—

	Bird.	Total.
1	Nightingale	125
2	Blackcap	112
3	Garden Warbler	103
4	Woodlark	101
5	Skylark	89
6	Song-thrush	89
7	Swallow	89
8	Dipper	88
9	Blackbird	88
10	Chaffinch	87
11	Reed-warbler	86
12	Meadow-pipit	85
13	Goldfinch	82
14	Linnet	79
15	Tree-pipit	78
16	Redbreast	76
17	Whitethroat	75
18	Willow-wren	72
19	Sedge-warbler	71
20	Starling	68
21	Wren	68
22	Pied Wagtail	65
23	Greenfinch	64
24	Redstart	62
25	Hedge-sparrow	61
26	Lesser Whitethroat	60
27	Whinchat	60
28	Wheatear	56
29	Missel Thrush	55
30	Stonechat	48
31	Bullfinch	41
32	Cirl-bunting	40
33	Reed-bunting	38
34	Goldcrest	35
35	Creeper	29
36	Tree-sparrow	28

In order still further to exhibit the comparative powers of our British birds, and at the same time to arrange their numerous notes in something like an orderly series, the following system is offered, which shows the *type* to which each song-bird belongs, and locates each bird in an ascending series, according to such type, beginning with those whose notes are least numerous and varied, and gradually rising to the most powerful and accomplished vocalists.

First—Birds which possess but a single note or *call.*

The greater number of birds, by very far, as I have before observed, come under this category, and therefore, however much this call may be varied in *tone,* they are necessarily excluded from the rank of *singing* birds.

Secondly—The first approach to song occurs when this single note is repeated several times without an interval, constituting a *prolonged call*, as I will designate it, as in the case of

1 Wryneck,
2 Woodpecker,
3 Nuthatch,
4 Swift,
5 Wood-warbler
6 Grasshopper Lark, &c.

Thirdly—The next advance is when, instead of a single note, the bird is capable of producing two notes, which Barrington designates the *varied call.* Such birds are the

1 Cuckoo,
2 Chiff-chaff,
3 Common Bunting, &c.

According to that part of Barrington's definition, which I am willing to accept, we now arrive at true singing birds, having three or more notes. These may be arranged as follows:—

Fourthly—Birds which sing short passages, which they repeat frequently, but from time to time vary,

A. with an interval between each repetition, as

1 Missel Thrush,
2 Golden Oriole,
3 Blackbird.

B. without such interval,

1 Blue Tit,
2 Great Tit,
3 Song-thrush.

Fifthly—Birds which have a *definite number of notes.* This includes all the poorer song-birds, which have but few notes, as well as some of the better class. These birds sing their song round, and then repeat it, singing nearly the same notes each time; so that when the observer has once mastered the passage, he cannot well be deceived in the bird; such are

1 Tree-sparrow,
2 Creeper,
3 Reed-bunting,
4 Cirl-bunting,
5 Gold-crest
6 Stonechat,
7 Wheatear,
8 Whinchat,
9 Hedge-sparrow,
10 Redstart,
11 Greenfinch,
12 Wren,
13 Willow-wren,
14 Tree-pipit,
15 Meadow-pipit,
16 Chaffinch.

And *Sixthly* and lastly, are those birds which possess an *indefinite number* of notes, so that no two passages are precisely alike, and the observer judges more by the *quality of the tone* than by the *identity of the passages.* This class includes the greater number of our true singing birds, and may conveniently be divided into two groups, viz:—

A. Those whose song is uttered in what the bird-catchers call *jerks*, that is, passages more or less brief, but always varied, and separated by an interval; such as—

1 Redbreast,
2 Whitethroat,
3 Lesser Whitethroat,
4 Blackcap,
5 Nightingale.

B. Those whose song is *long sustained*, without any rest or interval, as—

1 Pied Wagtail,
2 Starling,
3 Goldfinch,
4 Swallow,
5 Sedge Warbler,
6 Reed Warbler,
7 Linnet,
8 Garden Warbler,
9 Wood-lark,
10 Sky-lark.

Our indigenous birds appear, some of them at least, to be capable of singing nearly the whole year, excepting only during the moulting season, and this is certainly an argument against the sexual cause of song. The Robin, the Wren, the Starling, &c., may be heard through the frost and snow of January, although it is quite true that they improve greatly in their qualities of voice during the breeding season. Other birds gradually take up their song as the spring advances. The Missel and Song Thrush also usually sing in January. In the course of February, the Chaffinch, Hedgesparrow, Lark, Greenfinch, Goldcrest, &c., gradually chime in. The Blackbird is rarely heard till March, when he is accompanied by the Linnet and Goldfinch.

The month of April, however, brings with it a great accession of song, on account of the arrival of the exotic songsters which make our spring woods so vocal. These arriving, one after another, from the first week in April till the first week in May, very rapidly swell the chorus. Both indigenous and exotic songsters are, indeed, early in May, in full song—a marked improvement in tone and execution being observable even among those we have been accustomed to hear already for several months past. Thus, the Redbreast's note becomes full and sonorous, often rivalling the wild note of the Blackcap in some of its passages. The warble of the Chaffinch becomes more liquid, and an accession of power is generally noticeable. After the beginning of June, however, this climax begins to show symptoms of a decline: one by one, birds' voices are missed, or the rich tones deteriorate, and this process going on through June and July, it at length becomes the *exception* to hear a bird's song, instead of the rule; till at length, in August, a dead silence reigns in the woods and fields, and the birds are then as dumb as they are musical in May.

Whether this gradually increasing vocal power be due to a corresponding increase of pliability in the larynx, induced by practice, or to some correlative periodical change in the constitution of the bird, I cannot now enquire. Probably both causes are concerned, for we must take the analogous phenomenon of the decrease and disuse of song into consideration in any such enquiry.

Another question, too, presents itself, viz., what is the condition of migrating birds as to song, when they arrive among us? I think there can be little doubt that their vocal organs have previously reached their full pitch of power at that time, for several reasons.

First. They remain with us, in song, for so short a period (about six weeks) that time is scarcely allowed for any very great change; nor do we notice any in fact, the summer birds of passage being in good voice from the time they arrive till the time when their song begins to deteriorate.

Second. A careful observer will almost as soon learn by the *ear* as by the eye the arrival of summer birds, which announce their advent by their characteristic notes. I say *almost*, because it has several times occurred to me to see the bird only on one day, and to hear him on the next, and this under such circumstances as to leave no doubt that the fatigue of their journey only prevented them singing. On one occasion, in Kent, early in April, watching for the Willow-wren, not the slightest trace of which I had yet seen or heard, I espied one, which, while under my observation, uttered a mangled note, more like a recording note in autumn, and which I should scarcely have recognized. This was the only indication I had of the bird's arrival; but *next day* every tree-top resounded with the incessant warble of the species. A similar remark I have made with regard to the Redstart.

Thirdly, judging from analogy, we arrive at the same conclusion, for our winter birds of passage, which quit us in the spring, sometimes favour us with an audience before leaving.

After the period of silence, which marks the month of August, we often hear many species resume their song, but in a manner very far inferior to that of the spring months. The notes strike upon the ear like those of long absent friends, and as it always occurs to me, like those of friends just risen from a bed of sickness. Instead of the round, full, careless song of spring, we hear weak, vacillating and imperfect notes, which tell either of a loss of power, or of a newly commencing accomplishment. I certainly incline to the opinion expressed by White, and corroborated by the Rev. L. Jenyns, that these autumnal songsters are young cocks of the year. Without stopping to ask why the old birds should attempt to do that which they have not power to execute, it is to be borne in mind that this recommencement takes place at a time when we should look for the first indications of song in the young birds; at a time, that is, when they are fully fledged, and perfectly able to shift for themselves. But if it should prove that the weak notes heard in autumn, are produced by young cocks of the year, it will be a strong argument in favour of the *innate* character of song, and its specific nature. For the old birds have confessedly ceased for some weeks or months, and therefore it cannot be contended that the young are being instructed by them. Moreover, in any case the spring song ceases, as a rule, before the young are in a position to profit by it as an example, unless, indeed, it be hardily imagined that they bear in their remembrance the notes they heard many weeks before.

As there is an *annual* or seasonal cycle in the powers of singing-birds, so also there is a *diurnal* one. The daily cycle has, however, this peculiarity, that it reverses the annual one in its character—the earliest beginning of the day presenting a climax, which subsides before mid-day. It is not a little interesting to watch, in a spot thickly populated by birds, for the moment of their awakening. Long before sunrise, even in the longest days, and when only an uncertain glimmer of twilight exists, scarcely sufficient to read the time by a watch, a sudden awakening takes place. A single bird, more wakeful than his fellows, commences singing; but he does not long sing alone. Birds of the same species, as though awakened by the familiar sounds, almost instantly reply. By degrees, other species commence in the same manner; at first one individual, rapidly followed by others of the same species. A solitary thrush, for example, breaks the silence, and before five minutes have elapsed, a dozen thrushes may be heard singing in all directions, springing into life all around, as if by magic. The effect is most startling and curious.

The following extract from a carefully observed occurrence of the kind will illustrate this circumstance (May 18th):—

Hrs.	Min.	
3	5 (a.m.)	A Blackbird singing.
3	6 „	A Robin singing.
3	6½ „	Two or three Blackbirds and Robins singing.
3	7 „	A Thrush singing.
3	7½ „	A Ringdove cooing.
3	11 „	Ringdoves cooing; Blackbirds, Thrushes, and Robins singing *everywhere.*

No other time of the day can compare with this for the loudness and richness of the song of birds; and no one can have an idea of what a chorus of song-birds means, who has not heard it between three and four o'clock of a May morning.

There is a remarkable constancy, almost to a minute, in the awakening of birds at the same place and season; and in two observations made within three days at the same spot, the difference of time in the awakening of several of the commoner species was not more than a minute or two.

Much difference of opinion has existed as to what bird commences this morning chorus. Several writers who have touched upon this subject, have done so evidently without any special observation upon it with a view to determine the truth. In the "Journal of a Naturalist," the author gives the Rook the credit of being the first awake, and says the Robin is next. Jenner, in the Phil. Trans. (1824, p. 37), "On the Migration of Birds," says—"First the Robin, and not the Lark, as has generally been imagined, as soon as daylight has drawn the impenetrable line between night and day, begins his lonely song." Messrs. Sheppard and Whitear, in their paper "On the Birds of Norfolk" (Linnean Trans., vol. xv., p. 18), say, that the Redstart is the earliest bird, but without observation to back the assertion. For my own part, I distinctly dissent from all these, and in company with the poet, generally so true, and with the Rev. L. Jenyns, I believe that the Lark is, after all, the first to awaken and lead the choir. Thomson truly says—

> "Up springs the Lark,
> Shrill-voiced, and loud, the messenger of Morn."

And Jenyns, in his "Observations in Natural History" (pp. 95, et seq.) gives detailed results of his morning remarks upon that subject, which precisely correspond with similar observations which I have myself made with care. On all these occasions the Skylark has been fully half an hour carolling in the air before any other bird shewed symptoms of awakening. The Robin usually follows the Thrush, and the Cuckoo is one of the very earliest birds.

As the morning advances, the birds cease their song, and in the heat of the day there is as little music as in August; but as the sun declines many birds recommence, and even continue singing after the sun has absolutely set, as the Thrush and Robin; and the Cuckoo, as it is one of the earliest, so also it is one of the latest birds to retire.

Some birds, however, do not find a May day long enough to exhaust their powers, but are as vocal at midnight as at mid-day,—of such birds, the Nightingale, Woodlark, and Sedge Warbler are well known—but besides these the following have been occasionally heard during the night, viz. the Hedgesparrow, the Skylark, the Reed Warbler, the Robin, the Whinchat, and the Cuckoo.

Lastly, there are many birds whose characteristic mode of delivering their song is on the wing—such are the Skylark, Woodlark, Tree Pipit, Meadow Pipit, Whitethroat, Swallow, and Wagtail. To these may be added the following, which do not, as a rule, sing as they fly, but occasionally do so, viz., the Blackbird, the Wren, the Titmice, the Greenfinch, the Chaffinch, the Dartford Warbler, the Goldcrest, the Willow Wren, the Blackcap, the Missel Thrush, the Dipper, the Wheatear, and the Linnet.

There are many other points of great interest in connexion with this subject, to exhaust which would demand a volume. The musical aspect of the songs of birds is one of those which I should have liked to touch upon, but it is too extensive;

the curiosities and abnormalities of song—the docility and flexibility of the vocal organ of birds—their powers of uttering articulate sounds, &c. It is possible that I may resume the subject, however, on a future occasion.

FOURTEENTH ORDINARY MEETING.

Royal Institution, 29th April, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. Alexander Eccles, B.A., was elected a member.

Some discussion arose upon Dr. Collingwood's paper, read at the last meeting.

Mr. Moore, of the Free Public Museum, exhibited specimens of two collections of fishes, lately sent to the Museum—the one from Madeira, where they were collected by Mr. J. P. G. Smith and Mr. Yate Johnson, and forwarded to the Museum by the former gentleman; and the second collection had been recently received, through Dr. Collingwood, from Professor Agassiz, the eminent physiologist, of Cambridge, U.S., and was the first instalment of what might be looked forward to as a valuable and extensive addition to our Public Museum.

Dr. Collingwood laid upon the table the British Association dredging list, which, in conjunction with Mr. Byerley, he had filled up for the district of Liverpool. He stated that, having been requested by the British Association to furnish a report of the dredging in the Mersey and Dee, he wished to make known to naturalists generally that he would be very glad of information on, or specimens of, the following *desiderata,* viz., Tunicated Mollusca; the minuter Crustacea; the marine Entomostraca, infesting fishes; the marine worms of all classes; the Entozoa, or internal parasites of fishes; the genus Lepralia; the naked-eyed Medusæ; Foraminifera, and Sponges.

The following paper was then read:—

ON THE

PHILOSOPHY OF SIR WILLIAM HAMILTON.

BY CHARLES CLARK, ESQ.

In venturing to lay before you a paper on the Philosophy of Sir William Hamilton, I am aware that I lay myself open to the charge of presumption. Adequately to appreciate his labours in the great field of metaphysical science, would require not only a far larger knowledge of its past history than any to which I can lay claim, but also a deep prophetic insight into that conflict of opinions of which indications from time to time are manifested, but whose final issue it may be reserved for another generation to witness. My only apology for dealing with this subject is, that when I was urged by your secretary to write a paper, my thoughts instinctively turned towards that science which possessed the greatest interest for my own mind; and I cherished the hope that, in a philosophical society like this, some account of the teaching of the greatest philosopher of modern times might not be altogether unacceptable. In addressing you on this topic, I am aware that I labour under another disadvantage. The majority of your members have devoted themselves to the study of the various physical sciences, and may thence, perhaps, have been led to undervalue the importance of the science of mind. Certainly, if we dwell exclusively on the results hitherto attained, if we contrast the steady and gigantic progress which, since the time of Bacon, every branch of physical science has made, with the faltering steps and devious path of mental science during the same time, we may deplore, but we can scarcely be surprised, that such should be the case. On the one hand we see properties discovered, and laws of nature investigated, which not only add to the sum of our knowledge, but, in their artificial applications, and combinations, have multiplied immensely the powers and enjoyments of mankind. On the other hand, we find ourselves beset by contradictory theories, inexplicable phenomena, and insuperable difficulties; and we seem like the fallen angels of Milton:

> "In wand'ring mazes lost,"

to reach at last as the result of our speculations,

> "Not light, but rather darkness visible."

But if, turning from the consideration of mere tangible results, we take into our account the importance of the objects with which these sciences are respectively conversant—the material or physical world without, and the mental or psychical world within—we shall be forced to acknowledge that, worthy as is the boundless universe beyond of our admiration and study, the contemplation of our own mental being, of the powers and capacities which fix the boundaries and determine the conditions of thought, and through which alone knowledge is possible for us, is the highest and noblest that can engage our minds; and in this sense we may hold with Pope:

> "The proper study of mankind is man."

And as an additional incentive to this study, it should ever be remembered that, apart from revelation, it is only through the philosophy of mind, by recognizing in ourselves moral, intelligent, and spiritual agents, that we can rise to the conception of an intelligent Author and moral Governor of the universe, and establish our proof of the existence of a God. The poet just quoted speaks, indeed, of those who

"Rise from nature up to nature's God,"

but Sir William Hamilton has shown to demonstration that the only nature from which this inference can be legitimately drawn is the moral nature of man; for, whilst the universe of matter considered *by itself* presents us with an invariable succession of certain phenomena linked together by an inevitable law, revealing only a blind mechanical fate or necessity; the phenomena of man's moral nature, exhibited in consciousness, afford those attributes of freedom, intelligence, and goodness, which, carried to perfection and joined with Omnipotence and original causation, constitute our conception of the Deity. Kant, in a passage quoted by Sir Wm. Hamilton in his second lecture, has admirably discriminated the respective effects upon his mind of astronomical and moral science. He says:—"Two things there are which, the oftener and the more steadfastly we consider, fill the mind with an ever new, an ever-rising admiration and reverence—the starry heaven above; the moral law within. Of neither am I compelled to seek out the reality as veiled in darkness, or only to conjecture the possibility as beyond the hemisphere of my knowledge. Both I contemplate lying clear before me, and connect both immediately with my consciousness of existence. The one departs from the place I occupy in the outer world of sense; expands beyond the bounds of imagination this connexion of my body with worlds rising beyond worlds, and systems blending into systems; and protends it also into the illimitable times of their periodic movements, to its commencement and perpetuity. The other departs from my invisible self, from my personality; and represents me in a world truly infinite indeed, but whose infinity can be tracked out only by the intellect, with which, also, my connexion, unlike the fortuitous relation I stand in to all worlds of sense, I am compelled to recognize as universal and necessary. In the former, the first view of a countless multitude of worlds annihilates my importance as an animal product, which, after a brief, and that incomprehensible, endowment with the powers of life, is compelled to refund its constituent matter to the planet—itself an atom in the universe—on which it grew. The other, on the contrary, elevates my worth as an intelligence even without limit; and this through my personality, in which the moral law reveals a faculty of life independent of my animal nature, nay, of the whole material world; at least if it be permitted to infer as much from the regulation of my being, which a conformity to that law exacts; proposing as it does my moral worth for the absolute end of my activity, conceding no compromise if its imperative to a necessitation of nature, and spurning in its infinity the conditions and boundaries of my present transitory life."

It would be an interesting subject of inquiry to trace the causes, and examine the history, of that revival of the study of pure philosophy which has taken place in this country during the last thirty years. That such a revival exists is evident from our current national literature. It underlies the theological controversies which are waged amongst us; it has contributed to sustain, or undermine, rival systems of education, of morals, and of politics; it has penetrated the realms of fiction; and has given a colouring and direction to the genius of our most gifted living poet, who defines his mission:—

"As far as might be to carve out
Free space for every human doubt,
That the whole mind might orb about,

To search through all I felt or saw,
The springs of life, the depths of awe;
And reach the law within the law."

But this branch of inquiry would lead me too far from the immediate subject of this paper, and encroach too much upon the limited time, at my disposal to be further pursued now, and for the present I must reserve it; contenting myself with simply pointing your attention to the remarkable contrast which this interest presents, to the apathy, not to say the distaste, with which such studies were regarded not half a century ago. The next generation will scarcely believe that at a time within the memory of many now living, the study of the Philosophy of Mind was looked upon in England as little better than madness, and the name of a metaphysician had become a term of reproach. Nor was this prejudice confined to the ignorant and vulgar. If we may judge from the complaints of philosophical writers, and from the allusions to their science in the current literature of that day, we shall find this prejudice existing amongst many not otherwise deficient in learning and ability.

Is it not, then, worth our while to pause and ask for a moment, what were the causes of the disfavour with which metaphysical studies were so generally regarded, in a country distinguished among the nations of Europe for the number and acuteness of its metaphysical writers—the land of Scotus and Occam, of Locke and Clarke, of Hobbes and Butler, of Berkeley and Hume?—for unless we can believe such a revolution to have been merely accidental, the result of caprice and whim, we may expect to gain from an analysis of its causes valuable lessons for future guidance.

The first of these causes to which I would refer, is that confused and ambiguous use of terms which every philosopher has deplored, and few have avoided. This confusion and ambiguity, injurious in any science, is especially so in the science of Mind, where the phenomena to be observed and described are purely subjective, and in which, therefore, any ambiguity or uncertainty in the language employed to designate the phenomena, leads of necessity to erroneous results. This is so obvious that it might pass as a mere truism, but for the fact that some of those who, like Locke, have expatiated on the errors arising from this cause, have themselves, in their own writings, exhibited signal instances of its effects. Great as have been the services of Sir William Hamilton in other respects, there are few greater than those he has rendered in pointing out the errors of his predecessors which have sprung from an abusive employment of terms, and in introducing, and enforcing by his consistent practice, a more precise and accurate use of philosophical language.

Another cause, closely allied to, and partly springing out of, the one I have just named, was the conflict between the generally received theories with the common sense and natural beliefs of mankind. Developing the doctrine which the authority of Locke had supported, that the mind perceives nothing but its own ideas, and that "knowledge consists in nothing but the perception of the agreement or disagreement of these ideas," Berkeley maintained that there was no such thing in the universe as matter, that what appears to be such is merely an illusion of our senses, and that nothing exists but minds and spirits. Thus the theory of idealism was established on the ruins of the material world.

With equal cogency of argument, and equal disregard of common sense, the materialists reversed the argument; and since Locke had taught that all our ideas reach us primarily through the avenues of the senses, and must be either ideas of sensation, or of reflection founded upon sensations, they logically inferred that, as the phenomena of mind cannot be the objects of a sensation, such phenomena are in their nature illusive, and are in reality modifications of matter.

Emboldened by these contradictions, the sceptics entered the lists. Hume turned the weapons of the dogmatists against themselves, and proved with a merciless logic, which might be abused, but could not be refuted, that, assuming the truth of their own principles, there was in the universe neither mind nor matter, subject nor object; nothing but shadowy illusions, to which he gave the names of ideas and impressions—ideas existing without a mind to conceive them; and impressions without an object to produce, or a subject to receive them.

Listen to the following confession of Fichte, cited by Sir Wm. Hamilton, in his notes on Reid. He says:—"The sum total is this. There is absolutely nothing permanent either without me or within me, but only an unceasing change. I know absolutely nothing of any existence, not even of my own. I myself know nothing, and am nothing. Images there are; they constitute all that apparently exists, and what they know of themselves is after the manner of images; images that pass and vanish without there being aught to witness their transition; that consist, in fact, of the images of images, without significance, and without an aim. I myself am one of these images; nay, I am not even thus much, but only a confused image of images. All reality is converted into a marvellous dream, without a life to dream of, and without a mind to dream; into a dream made up only of a dream of itself. Perception is a dream. Thought, the source of all the existence, and all the reality which I imagine to myself of my existence, of my power, of my destination, is the dream of that dream."

Can we wonder that the instinctive belief of mankind revolted from these monstrous conclusions, and that the philosophy which led to them should have been repudiated, even by many who were unable to detect the fallacies that lurked beneath? Reid tells us that he himself first embraced the ideal system of Berkeley; but, startled at the frightful conclusions logically deduced from it by Hume, he was driven to examine the foundations upon which so amazing a superstructure was raised, and finding that it consisted of a mere hypothesis—destitute of proof and opposed to the universal convictions of mankind

—he determined, as he calls it, to appeal from philosophy to common sense; or, to speak more accurately, from the philosophy of conjecture to the philosophy of consciousness. This appeal to the intuitive beliefs of mankind, which he calls common sense, is the fundamental portion of Reid's philosophy, and forms, indeed, the connecting-link between his system and that of Sir Wm. Hamilton. It is true that Reid does not appear himself to have comprehended the full value of the principle he enunciated; that his language on the doctrine of perception is sometimes confused, ambiguous, and inconsistent; that his degradation of consciousness to a special faculty of the mind, instead of regarding it as the universal condition of thought, is unsatisfactory in the extreme; still, with all these defects, he is entitled to our warmest admiration as being the first in this country who, equally removed from the sensuism of Locke and the scepticism of Hume, endeavoured, not unsuccessfully, to build up a system of philosophy on just and rational foundations. I do not, of course, mean to assert that Reid was the sole author of what has since been called the Philosophy of Common Sense; it is rather for his merit as a reformer, calling attention to known, but generally forgotten or neglected, truths, that he deserves our esteem.

Partly, no doubt, in consequence of the inconsistencies I have named, the real import of Reid's doctrine of perception has been misapprehended by his successors—Stewart and Brown—and it was reserved for the illustrious subject of this evening's paper, to expound, correct, amplify, and illustrate it, with such fidelity of observation, felicity of language, and profundity of learning, as to stamp upon the sterling metal of Reid's philosophy the ineffaceable image and superscription of his own genius. I have already alluded to the accuracy and precision of Sir W. Hamilton's language. I cannot dwell upon this characteristic further than to remark, that in this respect alone, if in no other, his writings deserve the careful study of all who appreciate the luminous revelation of profound thought upon the most difficult and complicated subjects.

I shall now proceed to sketch as rapidly, yet as faithfully as I can, the main outlines of Sir Wm. Hamilton's system, leaving the details to be filled in on a subsequent occasion. These outlines are drawn from the essays originally published in the *Edinburgh Review*, and since re-published under the title of *Discussions on Philosophy*—the notes and dissertations appended to the collected volume of Reid's works, and the two volumes of Lectures on Metaphysics given to the world since the author's death, by Professor Mansel and Mr. Veitch.

The condition of philosophy is the possibility of knowledge; but knowledge is only possible in, and through, consciousness. We know, only as we are conscious of knowing; we feel, only as we are conscious of feeling; we will, only as we are conscious of willing. Consciousness is thus the universal condition of thought. It cannot be logically defined;—"as the one highest source of comprehensibility, it cannot be comprehended under anything else." But though not susceptible of logical definition, it may be philosophically analyzed, and the facts obtained by this analysis form the only substantial foundation of a legitimate psychology. There are certain conditions or limitations of consciousness on which all philosophers are agreed. These are: 1st, that consciousness is an actual, not a potential, knowledge; 2nd, that it is an immediate, not a mediate, knowledge; 3rd, that it supposes a contrast—a discrimination; 4th and 5th, that it involves judgment and memory. Consciousness being thus the generic condition of all knowledge, the possibility of philosophy involves the veracity of consciousness; "for as philosophy is only a scientific development of the facts which consciousness reveals, it follows that philosophy, in denying or doubting the testimony of consciousness, would deny or doubt its own existence." The value of this testimony is so admirably described in the following passage from Sir Wm. Hamilton's fifteenth lecture, that I quote it entire. He says:—"But if the testimony of consciousness be in itself confessedly above all suspicion, it follows that we inquire into the conditions or laws which regulate the legitimacy of its applications. The conscious mind being at once the source from which we must derive our knowledge of its phenomena, and the means through which that knowledge is obtained, psychology is only an evolution, by consciousness, of the facts which consciousness itself reveals. As every system of mental philosophy is thus only an exposition of these facts, every such system, consequently, is true and complete, as it fairly and fully exhibits what, and what only, consciousness exhibits. But, it may be objected, if consciousness be the only revelation we possess of our intellectual nature, and if consciousness be also the sole criterion by which we can interpret the meaning of what this revelation contains, this revelation must be very obscure, this criterion must be very uncertain, seeing that the various systems of philosophy all equally appeal to this revelation, and to this criterion, in support of the most contradictory opinions. As to the fact of the variety and contradiction of philosophical systems, this cannot be denied, and it is also true that all these systems either openly profess allegiance to consciousness, or silently confess its authority. But, admitting all this, I am still bold enough to maintain that consciousness affords not merely the only revelation and only criterion of philosophy, but that this revelation is naturally clear,—this criterion, in itself, unerring. The history of philosophy, like the history of theology, is only, it is too true, the history of variations, and we must admit of the book of consciousness what a great Calvinist divine bitterly confessed of the book of Scripture:

> 'Hic liber est in quo quærit sua dogmata quisque;
> Invenit et pariter dogmata quisque sua.'

In regard, however, to either revelation, it can be shown that the source of this diversity is not in the book, but in the reader. If men will go to the Bible, not to ask of it what they shall believe, but to find in it what they believe already, the standard of unity and truth becomes in human hands only a Lesbian rule. And if philosophers, in place of evolving their doctrines out of consciousness, resort to consciousness only when they are able to quote its authority in confirmation of their preconceived opinions, philosophical systems, like the sandals of Theramenes, may fit any feet, but can never pretend to represent the immutability of nature. And that philosophers have been, for the most part, guilty of this, it is not extremely difficult to show. They have seldom, or never, taken the facts of consciousness, the whole facts of consciousness, and nothing but the facts of consciousness. They have either overlooked, or rejected, or interpolated."

In founding a system of philosophy upon the data of consciousness, Sir Wm. Hamilton lays down three fundamental laws, or conditions of legitimacy, which he denominates —1st. The law of parcimony. 2nd. The law of integrity. 3rd. The law of harmony.

I. By the law of parcimony we are to understand that no fact is to be assumed as a fact of consciousness unless it be ultimate and simple. "Whenever," says Sir William Hamilton, "in our analysis of the intellectual phenomena, we arrive at an element which we cannot reduce to a generalization from experience, but which lies at the root of all experience, and which we cannot, therefore, resolve into any higher principle—this we properly call a fact of consciousness. Being thus a primary, it must also be a necessary condition of thought. It must be impossible not to think it. As ultimate, it must be accompanied with simple belief in its reality. We know that it is; we cannot know how or why it is. These facts are of two kinds:—1st. The facts given in the act of consciousness itself. 2nd. The facts which consciousness does not at once give, but to the reality of which it only bears evidence. Of the former, no doubt is, or can be, entertained; it is only of the latter that doubt is possible. It is not the reality, but the veracity of consciousness which is to be proved. II. By the law of integrity is meant that the whole of the facts of consciousness be taken into account. III. By the law of harmony, that nothing but the facts of consciousness, or inferences legitimately deduced from them, in due relation and subordination, be admitted; and that every position contradictory of them be rejected."

Such are the simple conditions which Sir Wm. Hamilton has prescribed for the investigation of the facts of consciousness. They are so obvious and self-evident that it might seem unnecessary formally to enunciate them, did not the history of philosophy show their constant and systematic violation. Hence, the various conflicting theories on the subject of perception, and the contradictory schemes of idealism, materialism, pantheism, scepticism, which have been based upon them. All these theories implicitly deny the veracity of consciousness, as manifested in the act of perception. In an act of perception I am immediately conscious, first of myself, the Ego, or subject knowing; second, of something different from myself—a non-Ego, or object known. Both are given in the same act of perception; they are known together, and known in contrast to each other. "When," says Sir Wm. Hamilton, "I concentrate my attention in the simplest act of perception, I return from my observation with the most irresistible conviction of two facts, or rather two branches of the same fact—that I am, and that something different from me exists. In this act, I am conscious of myself as the perceiving subject, and of an external reality as the object perceived; and I am conscious of both existences in the same indivisible moment of intuition. The knowledge of the subject does not precede nor follow the knowledge of the object—neither determines, neither is determined by, the other. The two terms stand in mutual counterpoise and equal independence." "Such is the fact of perception revealed in consciousness, and as such it determines mankind in general in their almost equal assurance of the reality of an external world, as of the existence of their own minds. Consciousness declares our knowledge of material qualities to be intuitive and immediate." This fact, as a phenomenon, is admitted even by those who deny the truth of its teaching. But though admitted as a phenomenon, the veracity of its testimony to aught beyond itself may be denied. It may be asserted that this phenomenon is merely illusive, that the non-Ego, or object, is merely a modification of the perceiving subject, or a *tertium quid* distinct from both, or that it is simply a representation of an unknown object in, and by, the subject. Or the testimony of consciousness to the ultimate duality of subject and object may be denied, or to their mutual equipoise and co-originality. According as one or other of these views is taken, idealism, materialism, absolute identity or pantheism, logically results. If the immediacy of our knowledge of the external world be denied, but the reality of its existence asserted, we have the doctrine which Hamilton designates cosmothetic idealism, or hypothetical dualism; the doctrine which, although of all others the most illogical and inconsistent, is that which has been received by the great majority of modern philosophers. These doctrines, though mutually repugnant, have yet one feature in common. They are all founded upon the denial, more or less complete, of the veracity of consciousness as manifested in external perception. But if consciousness be found a lying witness in this instance, why is its testimony to be believed in any? The original presumption in favour of its veracity is reversed—*Falsus in uno, falsus in omnibus;* and the line of Tennyson is philosophically true:

> "Unfaith in aught, is want of faith in all."

Can we discriminate between the deliverances of consciousness so as to pronounce that one is true and another false? This involves the assertion of a faculty higher than consciousness, which thus becomes the judge of its contents. But what is to guarantee the veracity of this higher power, which is only a consciousness once removed from that which is the object of our doubt? However far back we may carry our analysis, it is evident that we must come at last to those primary and ultimate facts which, as such, cannot be resolved into any higher principle, and as the basis of all our reasonings must necessarily be believed as true. These we have called the facts of consciousness. If, then, the testimony of these facts be disputed or denied, knowledge is a shadow and philosophy a dream. Thus Leibnitz says:—"If immediate internal experience, or consciousness, were able to deceive us, it would not be possible to have for me any truth of fact, I add, nor of reason." But if by philosophizing we assert the possibility of philosophy, we are not entitled to assume the mendacity of consciousness. The testimony of consciousness, like that of any witness, is to be believed unless it can be shown to be false. But as the sole possible witness, consciousness can only be condemned out of its own mouth. This would be the case if the facts of consciousness were mutually contradictory, either directly in themselves, or indirectly in the consequences to which they necessarily lead. If this can be shown, the authority of consciousness is subverted, and with it the possibility of knowledge. "But," I quote from Sir Wm. Hamilton, "it will argue nothing against the trustworthiness of consciousness that all, or any of its deliverances, are inexplicable, are incomprehensible; that is, that we are unable to conceive through a higher notion *how* that is possible, which the deliverance avouches actually *to be*. To make the comprehensibility of a datum of consciousness the criterion of its truth would be, indeed, the climax of absurdity. For the primary data of consciousness as themselves the conditions under which all else is comprehended, are necessarily themselves incomprehensible. We know, and can know only, that they are, not how they can be. To ask how an immediate fact of consciousness is possible, is to ask how consciousness is possible; and to ask how consciousness is possible, is to suppose that we have another consciousness before and above that human consciousness whose mode of operation we inquire. Could we answer this 'verily we should be as gods.'" But such repugnancy and self-contradiction of consciousness has not been, and cannot be proved; therefore, the evidence of consciousness is to be believed, and its testimony to the reality of our knowledge of the external world, of the mind or the subject knowing, of matter or the object known, of their co-existence, correlation, and equipoise, is to be accepted as true.

Such is a condensed account, given as nearly as possible in his own language, of Sir Wm. Hamilton's doctrine of the Evidence and Authority of Consciousness in Perception. It is to his system of philosophy what the Newtonian law of gravitation is to the science of astronomy, or the law of the equality of the angles of incidence and reflection to that of optics. It is the corner-stone of his Psychology, and on this solid and immovable basis he has reared an edifice, against which the rains may descend, and the floods come, and the winds of adverse prejudices may blow, without shaking or disturbing it, "for it is founded on a rock."

I shall conclude with briefly noticing Sir William Hamilton's doctrine of the Limitations of Human Knowledge, or, as it has been termed, "The Philosophy of the Conditioned." Is the domain of human knowledge co-extensive with the universe of existence? Is pure being, as it exists in itself and out of relation, an object of knowledge for us? Are our faculties competent to the immediate knowledge of the infinite and absolute; that is, of the unconditionally unlimited and the unconditionally limited? These are the questions that meet us on the threshold of philosophy. This intuition of the absolute and infinite has been the dream of philosophers from the dawn of speculation unto the present day. It underlies the whole scheme of mystical theology, and its possibility is regarded by Fichte and Schelling as requisite to afford a valid basis for a real philosophy. To reach it, system has been reared on system,

> "High as the tower which builders, vain,
> Presumptuous, piled on Shinar's plain;"

and the result has been alike, a "confusion of tongues." To these questions Sir Wm. Hamilton returns a direct negative. All knowledge exists in and by consciousness, but consciousness is only possible under the conditions of difference, plurality, and relation; and is, therefore, only of the conditioned, the relative, the phenomenal, the finite. The absolute—that which exists absolutely in itself and out of relation—and the infinite—cannot be objects of positive thought; they can only be conceived by abstracting the conditions under which thought is realized; they are negations of the conceivable. But, though inconceivable, they are not, therefore, to be regarded as non-existent. All positive thought is of the conditioned, and is "the mean between two contradictory extremes, both of which are inconceivable, but of which, as contradictories, one or other must, by the fundamental laws of thought, be admitted as necessary." "The mind is not represented as conceiving two propositions subversive of each other as equally possible; but only as unable to understand, as possible, either of two extremes; one of which, however, on the ground of their mutual repugnance, it is compelled to recognize as true."

"We are thus taught the salutary lesson that the capacity of thought is not to be constituted into the measure of existence; and are warned from recognizing the domain of our knowledge as necessarily co-extensive with the horizon of our faith. And by a wonderful revelation we are thus, in the very consciousness of our inability to conceive aught above the relative and finite, inspired with a belief in the existence of something unconditioned beyond the sphere of all comprehensible reality."

The end, therefore, of this philosophy is the knowledge of our own ignorance. The conflicting claims of faith and reason are reconciled, and the boundaries of each determined. Reason is shown to be limited, but not fallacious. Faith is seen to be the complement of reason. Either without the other is inadequate to the whole of man's being. Those who assert the sufficiency of reason, whose speculations have never carried them as far as that "wall of adamant" which closes in all human knowledge, and of which, to use the metaphor of Sir James Mackintosh, "few suspect the existence until they are dashed against it," may echo the watchword of Abelard,—*Intellige ut credas;* but those who have fathomed the depths of consciousness, and explored the boundaries of human knowledge, will be inclined to accept the advice of the Prophet,—*Crede ut intelligas,* as the dictate alike of a higher faith and a profounder philosophy.

The CHAIRMAN having invited discussion;—

Mr. BIRCH bore testimony to the general accuracy with which the principles of Sir William Hamilton had been expressed in the paper. He drew especial attention to the threefold division, by Sir William Hamilton, of the Philosophy of Mind, into Phenomenology, Nomology, and Ontology, and expressed his deep regret that whilst the two former had been fully treated in the Lectures on Metaphysics and Logic, we did not possess any similar exposition of the latter.

The Rev. Mr. MACNAUGHT could not admit what appeared to be the practical result of this philosophy. We had no right to require belief in that which was incapable of logical proof; but the proof of a given fact did not necessarily involve a knowledge of its mode of existence. That which could not be logically defined was unintelligible, and, therefore, unworthy of belief. Referring to Bishop Berkeley's system, he thought it had been somewhat misunderstood. He did not think Berkeley meant to deny the existence of matter, but simply the existence of *substance*, as distinct from, and independent of, the *qualities* of matter.

Dr. **Ihne** complained that Sir William Hamilton had not solved the great problem of philosophy, *i.e.*, the knowledge of the absolute and the infinite. All philosophers, from Plato downwards, had split upon the rock of the absolute, and Sir William Hamilton had avoided the danger instead of overcoming it.

Mr. **Clark** then replied,—All knowledge departed from certain primary principles, which must be assumed to be true, though as being the basis of our reasoning they were incapable of logical proof, *i.e.*, of being deduced from higher principles than themselves. It was erroneous to suppose that nothing was to be believed which was not susceptible of being logically defined and proved. The facts of consciousness could not be so established, yet it was impossible to doubt their existence. Take the example of time. Either time had a commencement, or it had not. But it was impossible to conceive, *i.e.*, to construe positively in thought an absolute commencement of time; in other words, a period so remote that we could conceive nothing beyond it. On the other hand, it was equally impossible to conceive an absolutely unlimited, or infinite time, for that, amongst other difficulties, would require an infinite amount of time for its accomplishment. Both these notions are equally inconceivable—both are equally beyond the grasp of the logical understanding; but one or other must necessarily be believed as true. Precisely the same reasoning may be applied to the doctrine of space; and it might be shewn that whilst the notion of space as absolutely limited, on the one hand, or as infinite on the other, was inconceivable; one or other must, necessarily be believed as true. It would be easy to multiply indefinitely illustrations of the same principle; and so far from its being true that all belief rested upon logical demonstration, a careful analysis would shew that all demonstration rested upon assumptions necessarily believed, but unsusceptible of proof. The objection of Dr. Ihne might apply to those philosophers who, like Fichte, Schelling, and Cousin, asserted the immediate knowledge of the absolute and infinite to be the end of philosophy; but did not apply to Sir Wm. Hamilton, who declared at the outset that, by man, with his present faculties, such knowledge was unattainable. The services of Sir William Hamilton to philosophy were not, as had been asserted, purely negative; on the contrary, by showing the impossibility of arriving at truth in the direction hitherto sought, he has concentrated attention upon those paths in which she might certainly be found.

On the motion of the **President**, the thanks of the Society were unanimously voted to Mr. Clark for the paper he had read.

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